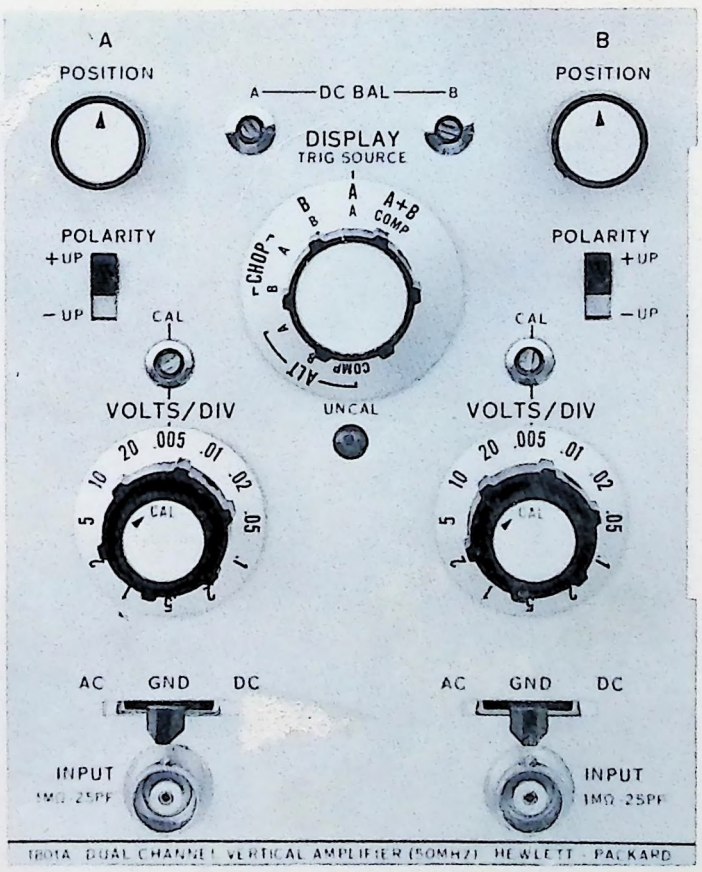
OPERATING AND SERVICE MANUAL

DUAL CHANNEL VERTICAL AMPLIFIER

1801A



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CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

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OPERATING AND SERVICE MANUAL

MODEL 1801A
DUAL CHANNEL VERTICAL AMPLIFIER

SERIALS PREFIXED: 1439A

Refer to Section VII for instruments with the following serial prefix numbers: **936–, 949–, 951–, 966–, 969–, 1130A, 1132A, 1214A, and 1220A.**
Refer to Section VII for information covering the following Options: **001, 003, 090, and 091.**

HEWLETT-PACKARD COMPANY/COLORADO SPRINGS DIVISION
1900 GARDEN OF THE GODS ROAD, COLORADO SPRINGS, COLORADO, U.S.A.

Manual Part Number 01801-90914
Microfiche Part Number 01801-90814

PRINTED: OCT 1974

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT.

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE.

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS.

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

Dangerous voltages, capable of causing death, are present in this instrument.
Use extreme caution when handling, testing, and adjusting.

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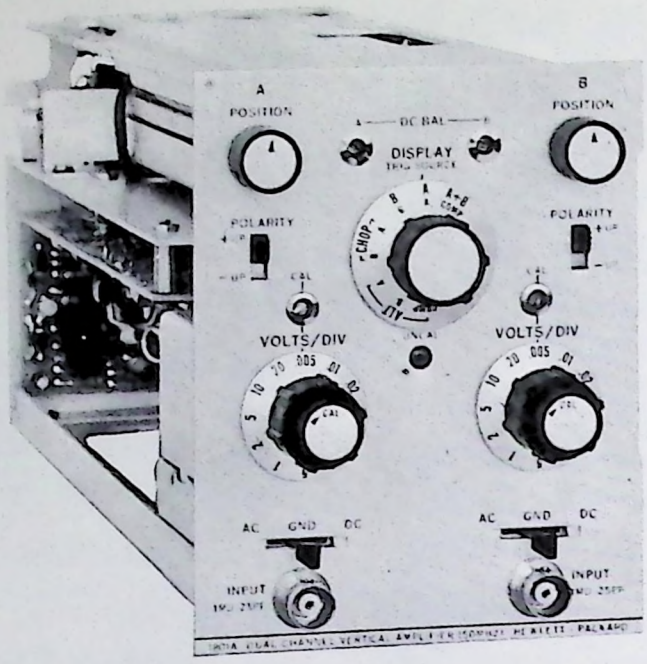

Figure 1-1. Model 1801A Dual Channel Vertical Amplifier

Table 1-1. Specifications

MODES OF OPERATION

Channel A alone;
Channel B alone;
Channels A and B displayed alternately on successive sweeps (ALT);
Channels A and B displayed by switching between channels at approximately 400 kHz (CHOP), with blanking during switching;

EACH CHANNEL (2)

Deflection Factor (sensitivity): 0.005 V/DIV to 20 V/DIV (12 calibrated positions) in 1, 2, 5 sequence; vernier extends maximum deflection to 50 V/DIV; a sensitivity calibration adjustment for each channel is provided on the front panel.
Attenuator Accuracy: ±3%.
Bandwidth: DC-coupled, dc to 50 MHz; AC-coupled, approximately 8 Hz to 50 MHz. (Measured with or without HP Model 10004B probe; 8-div reference signal from a 25-ohm source, 50-ohm terminated. Lower limit is approximately 0.8 Hz with HP Model 10004B probe).
Rise time: Less than 7 ns (measured with or without HP Model 10004B probe: 10% to 90% of 8-div input step from 25-ohm source, 50 ohms terminated).
Input RC: 1 megohm shunted by approximately 25 pF, constant on all ranges.
Maximum Input Signal: AC-coupled, ±600 Vdc; DC-coupled, ±350 V (dc + pk ac); ±150 V (dc + pk ac) on 5 mV/div at 10 kHz or less.
Polarity Presentation: +UP or —UP, selectable.

A + B INPUT

Amplifier: bandwidth and deflection factor are unchanged; either channel may be inverted to give ±A ±B operation.
Differential Input (A-B) common mode; for frequencies from dc to 1 MHz, common-mode rejection ratio is at least 40 dB on 5-mV/div deflection factor, at least 20 dB on other ranges; for common-mode signals of 24-div deflection or less.

TRIGGERING

Source:
Channel A or Channel B alone, or Channel A plus Channel B; on the signal displayed.
CHOP Mode: Selectable from Channel A signal or Channel B signal.
ALT (alternate) Mode: Selectable from either Channel A signal or Channel B signal or successively from the displayed signal on each channel.
Frequency:
Dc to 50 MHz on signals causing 0.5 div p-p or more vertical deflection in all display modes except CHOP; dc to 100 kHz for CHOP mode.

GENERAL

Weight: Net, 4 lb (1.8 kg); shipping, 7 lb (3.2 kg).
Accessories Furnished: Two HP Model 10004B 10:1 Voltage Divider Probes.

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This section contains instrument description and scope of manual. Instrument identification and manual changes are covered next followed by a brief description of accessories and option instruments.

1-3. INSTRUMENT DESCRIPTION.

1-4. The Hewlett-Packard Model 1801A Dual Channel Vertical Amplifier (Figure 1-1) is a versatile wide-band plug-in unit for the HP 180-series oscilloscopes. Throughout this manual the Hewlett-Packard Model 1801A Dual Channel Vertical Amplifier will be referred to as the Model 1801A. Dual-channel capability allows display of one signal alone or two signals simultaneously. Two waveforms can be superimposed, each with the full 8-division amplitude. Both channels in the Model 1801A have bandwidth of 50 MHz, a risetime of less than 7 ns, and a minimum calibrated deflection factor of 5 millivolts per division. The maximum calibrated deflection factor is 20 volts per division and a vernier extends the deflection factor to 50 volts per division.

1-5. In addition to display of either signal alone, a chopped display or an alternating display of two signals is possible. With a chopped display, switching occurs at a 400 kHz rate and the CRT trace is automatically blanked during switching (eliminating undesirable channel switching transients from the display). Channel A plus Channel B (algebraic addition) may also be selected and either channel can be inverted to obtain a differential (±A ±B) display. Common-mode rejection ratio for differential amplifier operation is at least 40 dB at 5 millivolts per division and 20 dB on other deflection factors for frequencies up to 1 MHz and 24 divisions of deflection or less.

1-6. The sync amplifier of the Model 1801A synchronizes the time base. The display can be synchronized with either Channel A alone or Channel B alone or with a signal displayed in A+B. With an alternate display, the triggering can be selected from either Channel A, Channel B, or the composite signal. For a chopped display, triggering can be selected for Channel A or Channel B signals. Complete specifications for the Model 1801A are provided in Table 1-1.

1-7. SCOPE OF MANUAL.

1-8. This manual provides operating and service information for the Model 1801A and supplements the information presented in the operating and service manual for the HP 180-series oscilloscopes. For specific information on other HP 180-series plug-ins, refer to the manual for specific plug-in units. When using this manual refer to Table 1-2 for abbreviation identification.

1-9. INSTRUMENT IDENTIFICATION.

1-10. Hewlett-Packard uses a two-section serial number to identify instruments. The first section identifies a specific series of instruments; the last section identifies a particular instrument in that series. The serial number appears on a plate located on the rear panel. Reference the model number and the complete serial number when contacting a Hewlett-Packard Sales/Service Office in regard to an instrument (see Figure 1-2).

CAUTION

The warranty is void for instruments having mutilated serial number tags.

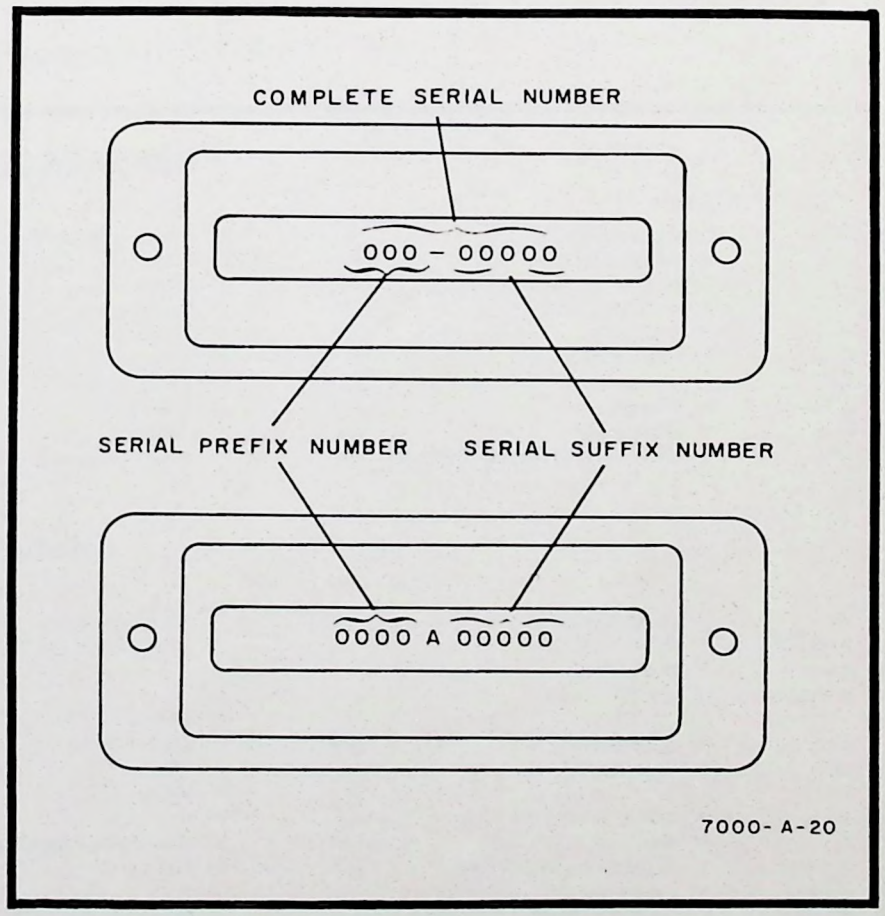

Figure 1-2. Serial Prefix Identification

1-11. MANUAL CHANGES.

1-12. This manual provides complete information for any Model 1801A with a serial number prefixed (Paragraph 1-9) by the same number indicated on the title page. If the

serial prefix of the instrument is different from that shown on the title page, a yellow MANUAL CHANGES insert supplied, or Section VII of the manual, will describe changes required to adapt this manual to provide correct coverage. Errors in print are called ERRATA and the corrections are shown on the MANUAL CHANGES insert. For information on manual coverage of any Hewlett-Packard instrument, contact the nearest Hewlett-Packard Sales/Service Office (addresses are listed at the rear of this manual).

1-13. ACCESSORIES FURNISHED.

1-14. The Model 1801A is supplied with two Model 10004B (3-1/2 foot cable) 10:1 voltage divider probes. Operating, maintanance, and parts information for the probes are contained in Appendix I at the rear of this manual.

1-15. OPTIONS.

1-16. There are three options available for the Model 1801A. Option 001 provides for a Channel B Vertical output signal at the front panel and times-five magnification for the vertical signal. Refer to Section VII for operating, maintenance, and parts information for Option 001. Option 090 replaces the two standard Model 10004B probes with two Model 10006B (approximately 6 feet long) 10:1 voltage divider probes. Option 091 replaces the two standard Model 10004B probes with two Model 10005B (approximately 10 feet long) 10:1 voltage divider probes. Refer to Appendix I at the rear of this manual for complete operating, maintenance, and parts information for the probes.

Table 1-2. Reference Designators and Abbreviations

REFERENCE DESIGNATORS

A	= assembly	E	= misc. electrical part	P	= plug	U	= integrated circuit (unrepairable)
AT	= attenuator, resistive termination	F	= fuse	PS	= power supply	V	= vacuum tube, neon bulb, photocell, etc.
B	= motor, fan	FL	= filter	Q	= transistor	VR	= voltage regulator (diode)
BT	= battery	H	= hardware	R	= resistor	W	= cable
C	= capacitor	J	= Jack	RT	= thermistor	X	= socket
CP	= coupling	K	= relay	S	= switch	Y	= crystal
CR	= diode	L	= inductor	T	= transformer	Z	= network
DL	= delay line	LS	= speaker	TB	= terminal board		
DS	= device signaling (lamp)	M	= meter	TP	= test point		
		MP	= mechanical part				

ABBREVIATIONS

A	= ampere(s)	FET	= field-effect transistor(s)	n	= nano (10^{-9})	rfi	= radio frequency interference
ampl	= amplifier(s)			nc	= normally closed		
assy	= assembly			no.	= normally open	rms	= root mean square
ampltd	= amplitude			npn	= negative-positive-negative	rwv	= reverse working voltage
		G	= giga (10^{9})				
bd	= board(s)	gnd	= ground(ed)	ns	= nanosecond		
bp	= bandpass					SCR	= silicon controlled rectifier
		H	= henry(ies)				
c	= centi (10^{-2})	hr	= hour(s)	p	= pico (10^{-12})	sec	= second(s)
C	= carbon	HP	= Hewlett-Packard	pc	= printed (etched) circuit(s)	std	= standard
ccw	= counterclockwise	Hz	= hertz				
coax.	= coaxial			pk	= peak	trmr	= trimmer
coef	= coefficient	if.	= intermediate freq.	pnp	= positive-negative-positive		
com	= common	intl	= internal			u	= micro (10^{-6})
CRT	= cathode-ray tube			p/o	= part of	usec	= microsecond
cw	= clockwise	k	= kilo (10^{3})	p-p	= peak-to-peak		
				prgm	= program	V	= volts
d	= deci (10^{-1})	lb	= pound(s)	prv	= peak inverse voltage(s)	var	= variable
dB	= decibel	lpf	= low-pass filter(s)				
				ps	= picosecond	w/	= with
ext	= external	m	= milli (10^{-3})	pwv	= peak working voltage	w/o	= without
		M	= mega (10^{6})			wiv	= working inverse voltage
F	= farad(s)	ms	= millisecond	rf	= radio frequency		

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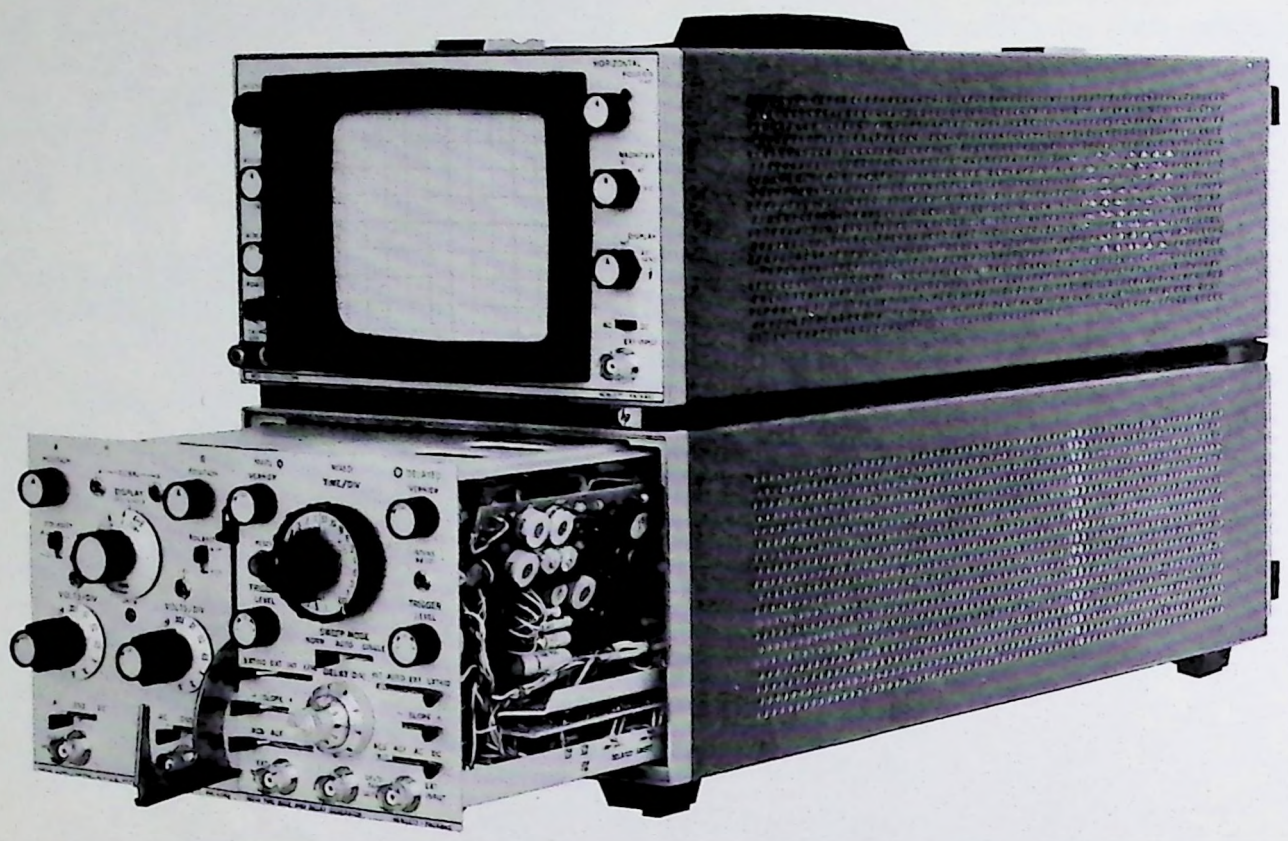


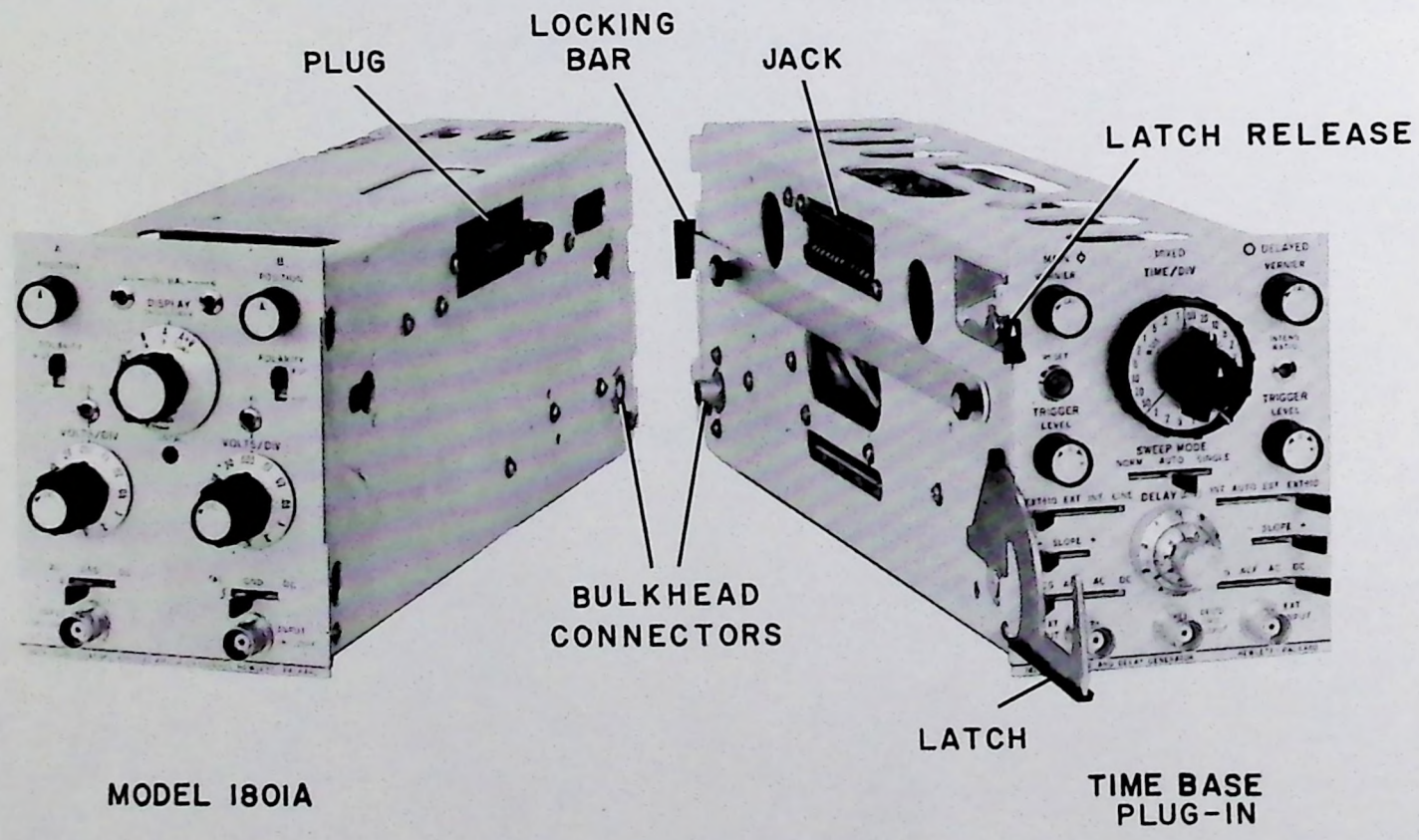


Figure 2-1. Plug-in Mating

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains initial inspection, claims, and repackaging information. Also in this section is a preparation-for-use procedure and instrument-compatibility information.

2-3. INITIAL INSPECTION.

2-4. MECHANICAL CHECK.

2-5. Inspect the Model 1801A for physical damage such as bent or broken parts and dents or scratches. If damage is found, refer to Paragraph 2-8 for the recommended claim procedure. If the Model 1801A appears undamaged, perform the electrical check (Paragraph 2-6). Retain the packaging material for possible future use.

2-6. ELECTRICAL CHECK.

2-7. The performance check is given in Paragraphs 5-5 through 5-17. This check will determine whether or not the instrument is operating within its specifications as listed in Table 1-1. The initial performance and accuracy of this instrument are certified as stated on the inside front cover of this manual. If the Model 1801A does not operate as specified, refer to Paragraph 2-8 for the recommended claim procedure.

2-8. CLAIMS.

2-9. If physical damage is found or if the instrument does not operate within specifications when received, notify the carrier and the nearest Hewlett-Packard Sales/Service Office immediately. The Sales/Service Office will arrange for the repair or replacement of the instrument without waiting for a claim to be settled with the carrier.

2-10. The warranty statement for the Model 1801A is on the inside front cover of this manual. Contact the nearest Sales/Service Office for information about warranty claims.

2-11. REPACKAGING FOR SHIPMENT.

2-12. If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office, attach a tag to it showing owners name and address, instrument model number and serial number, and a description of the services required.

2-13. If the original shipping carton and packaging materials are not available or reusable, repack the instrument with the following materials.

a. A double-walled carton (refer to Table 2-1 for test strength required).

b. Heavy paper or sheets of cardboard to protect all instrument surfaces (use a nonabrasive material such as polyurethane or a cushioned paper such as Kimpak around all projecting parts).

c. At least 4 inches of tightly-packed, industry-approved, shock-absorbing material, such as extra-firm polyurethane foam.

d. Heavy-duty shipping tape to secure outside of carton.

Table 2-1. Shipping Carton Test Strength

Gross Weight (lb)	Carton Test Strength (lb)
up to 10	200
10 to 30	275
30 to 120	350
120 to 140	500
140 to 160	600

2-14. PREPARATION FOR USE.

2-15. The Model 1801A and the time base plug-in are locked-together and inserted as a unit into the plug-in compartment of the HP 180-series oscilloscope. This procedure is explained below. Power for the Model 1801A is supplied by the oscilloscope through the time base plug-in.

2-16. Install plug-ins as follows:

a. Move locking bar to rear (Figure 2-1).

b. Fit Model 1801A plug into time base jack (make certain that bulkhead connectors are aligned) and press plug-ins firmly together.

c. After ensuring that front and rear panels are aligned, push locking bar forward.

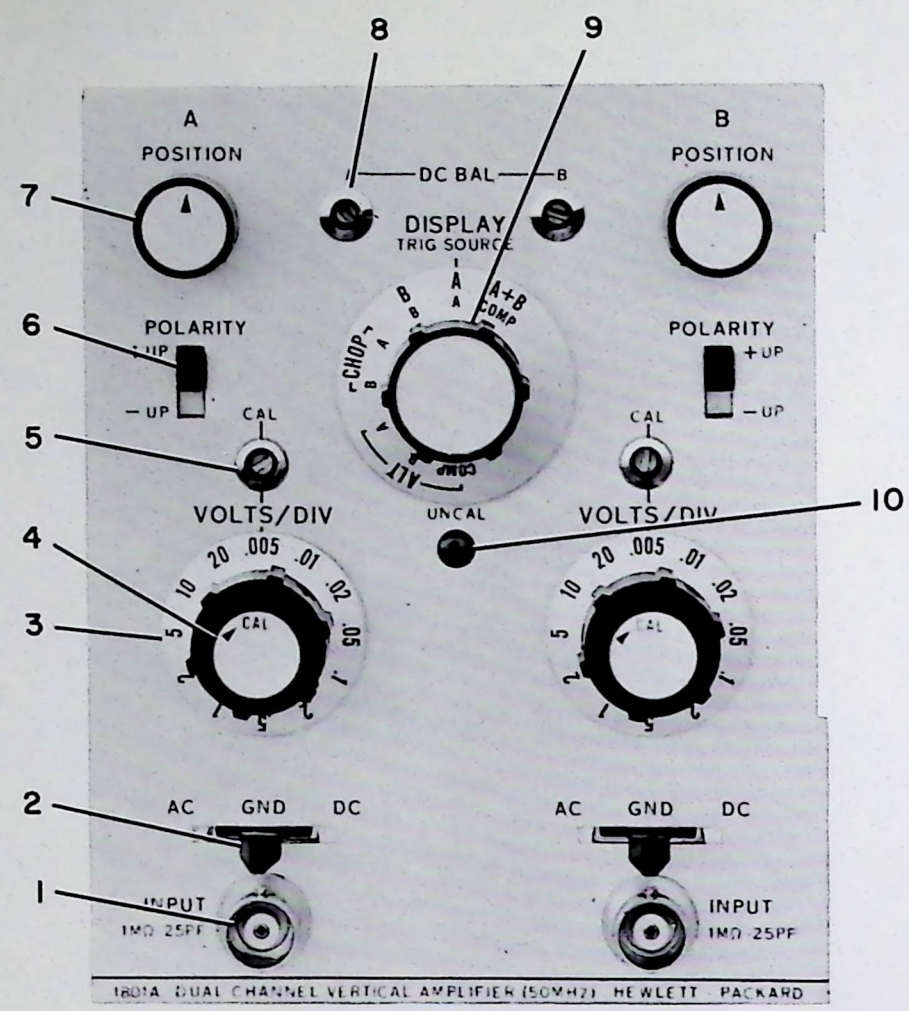
d. Rotate latch downward and insert plug-ins into HP 180-series oscilloscope.

e. Rotate latch upward and push in to lock.

2-17. INSTRUMENT COMPATIBILITY.

2-18. The Model 1801A can be used in the HP 183-series oscilloscope mainframe. To ensure the operation in Table 1-1 when used with a HP 183-series oscilloscope mainframe, connect a short jumper wire (a piece of transistor leader equivalent) between the two brass eyelets. They are labeled 180 and 183 and are located near A3C29 and A3C42 at rear of board. After this change recheck the calibration (refer to Paragraphs 5-18 through 5-29 for recalibration) to ensure proper operation.

2-19. When preparing Model 1801A for use in HP 180-series oscilloscope mainframe, remove the short jumper wire and perform the adjustment procedure Paragraphs 5-18 through 5-29.



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1. INPUT. Input signal BNC connector.

2. Coupling (AC-GND-DC). Selects capacitive (AC) or direct (DC) coupling of input signal, or grounds amplifier stage while disconnecting INPUT.

3. VOLTS/DIV. Selects vertical deflection factor necessary for calibrated measurements.

4. Vernier. Provides continuous adjustment of volts/div between calibrated positions of VOLTS/DIV switch.

5. CAL. Adjustment to calibrate amplifier with setting of VOLTS/DIV switch.

6. POLARITY. Selects between normal (+UP) or inverted (–UP) display.

7. POSITION. Varies vertical position of display.

8. DC BAL. Adjustment to minimize vertical shift of trace when POLARITY is switched.

9. Vertical DISPLAY. Selects type of display; either single channel or dual channel and also selects trigger source.

10. UNCAL. Lighted when vernier is out of fully clockwise CAL detent.

Figure 3-1. Controls and Connectors

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section contains description and operation of instrument controls and connectors. Use of the probes supplied with the instrument is also covered. The amount of vertical display required to supply a trigger signal to time base along with operating procedures for various modes of operation are covered in this section.

3-3. CONTROLS AND CONNECTORS.

3-4. Locations of controls and connectors are shown in Figure 3-1 along with a brief description of their functions. Controls that perform the same function in each channel are explained for Channel A only. The following paragraphs describe some control functions in more detail.

3-5. COUPLING (AC-GND-DC).

3-6. This lever switch selects either capacitive (AC) or direct (DC) coupling of the input signal to the Model 1801A, or it grounds (GND) the Model 1801A input stage while disconnecting the input signal. Use the DC position when viewing long duration pulses or dc levels of waveforms. Use the AC position when viewing ac waveforms having large dc levels. GND position is used to disconnect the signal source from the input of the Model 1801A and at the same time ground the input. Use the GND position to establish a reference.

3-7. DISPLAY.

3-8. This control selects the type of display. Input signals may be displayed either singly or simultaneously as explained below.

a. Displays Channel A input on CRT and selects A Channel as a trigger source.

b. Displays Channel B input on CRT and selects B Channel as a trigger source.

c. A + B displays algebraic sum of Channel A and B inputs on CRT. The POLARITY setting on each channel determines whether display is the sum or difference of input amplitudes The possible algebraic combinations are A + B, −A −B, A − B, and B − A. The trigger source is the composite signal.

d. ALT. Each input signal is displayed on alternate sweeps. If ALT mode is used with slow sweep times, display will flicker. Either the Channel A signal, Channel B signal or composite switching signal can be selected and applied to time base plug-in to trigger the sweep. For accurate time comparisons at fast sweep times, use Channel A trigger or Channel B trigger as reference for time comparison. Use ALT mode with composite trigger source to trigger when viewing two non-time related signals. The availability of selecting Channel A, Channel B, or composite switching signal for trigger generation is called selectable triggering.

e. CHOP. Presents a separate display of each input. Both inputs are displayed during the same sweep by switching between each channel at a rate of 400 kHz. Use CHOP mode with sweep time slower than 1 ms because the switching interval at higher frequencies becomes visible. Either Channel A or Channel B input signal can be selected as the internal trigger and this function is called selectable triggering.

3-9. INPUT PROBES.

3-10. Two HP Models 10004B 10:1 divider probes are supplied with each Model 1801A. Use these probes whenever possible since the high input impedance greatly reduces loading of the circuit under test. Multiply the selected deflection factor by ten to correct for the 10:1 voltage division of the probe. When it is not possible to use the Model 10004B probes, use a shielded cable. Unshielded leads may couple unwanted signals into the input.

3-11. INTERNAL TRIGGER.

3-12. A vertical input signal that will provide a 0.5-division vertical deflection on the CRT will properly trigger the time base. Figure 3-2 illustrates the display amplitude as a function of frequency. The curve shown is

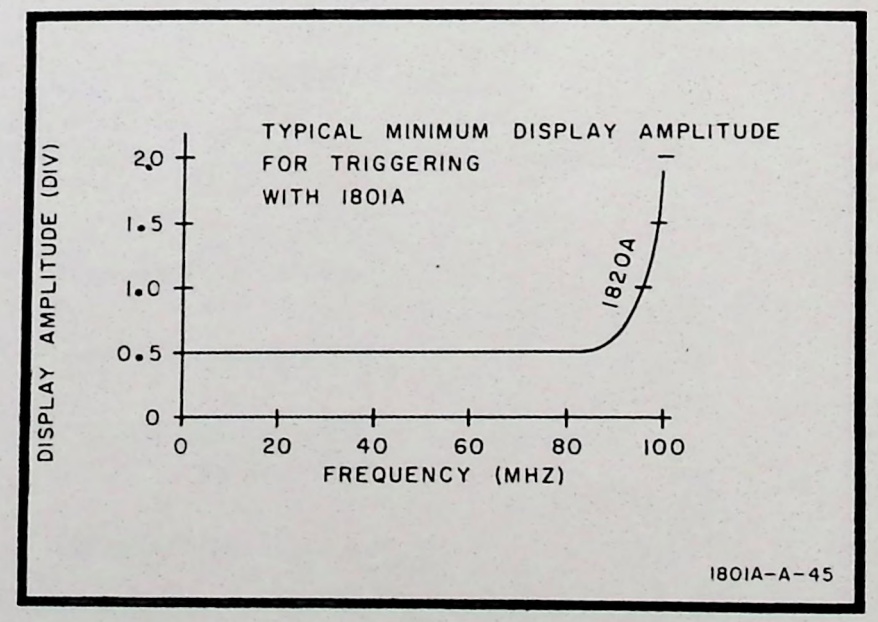
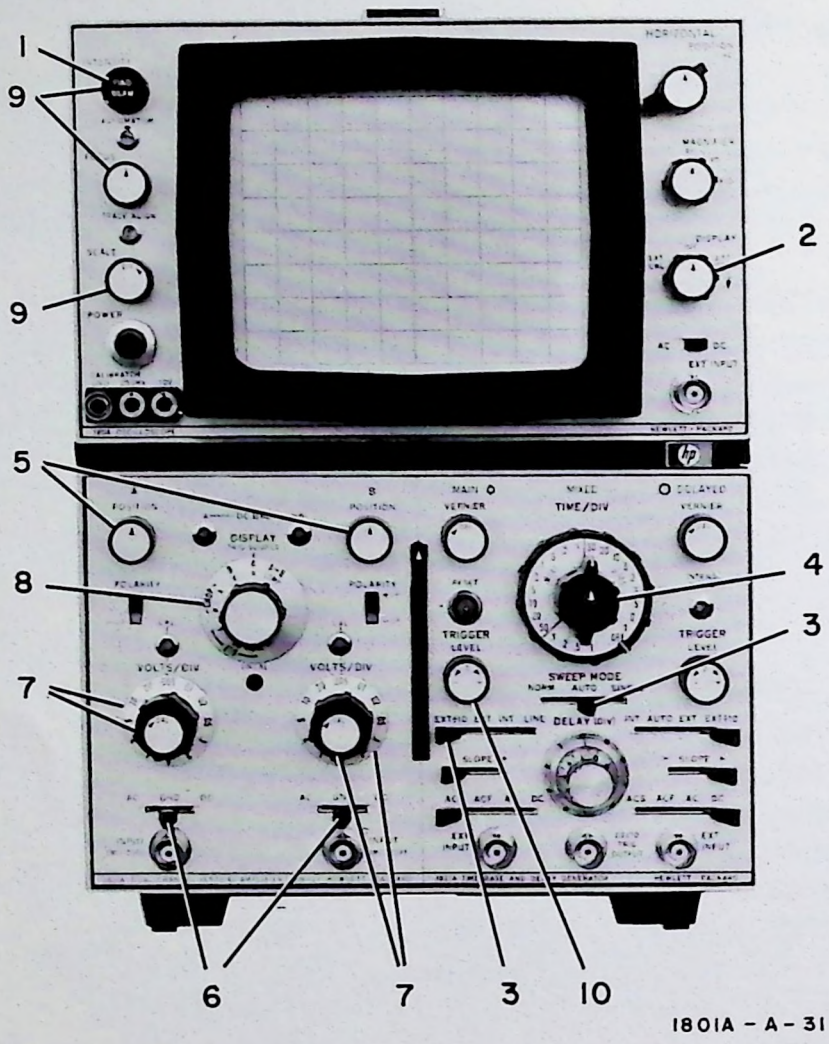


Figure 3-2. Internal Trigger Amplitude

typical for Model 1820A. Curves for Model 1821A main and delayed operation are similar. Use this graph in conjunction with the trigger amplitude requirements of the time base plug-in.

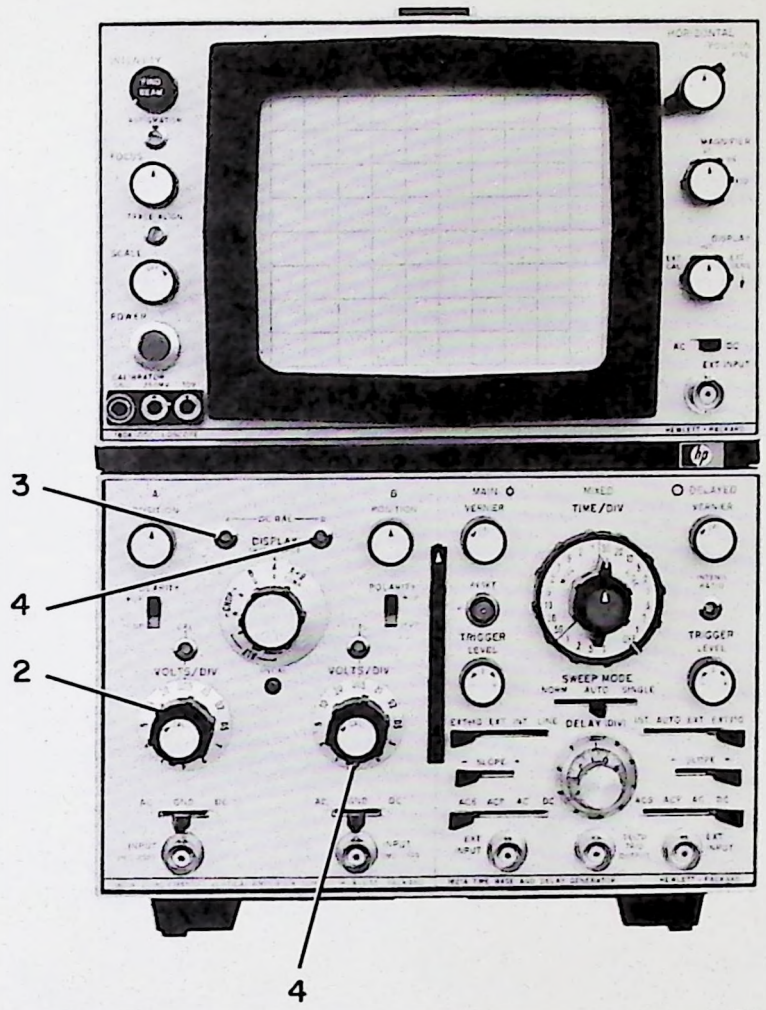
3-13. OPERATING INSTRUCTIONS.

3-14. Figures 3-3 through 3-9 give step-by-step operating instructions for the Model 1801A. These instructions are keyed on the photograph in each figure with index numbers. Read the preceding paragraphs before operating the instrument as they contain additional information about the Model 1801A.



1. Set INTENSITY fully counterclockwise.
2. Set oscilloscope DISPLAY to INT.
3. Set time base SWEEP MODE to AUTO and trigger source (main) to INT.
4. Set time base TIME/DIV (main) to .2 ms.
5. Set A and B POSITION controls to midrange.
6. Set A and B Coupling switches to GND.
7. Set A and B VOLTS/DIV controls to 2 and A and B VERNIER controls fully clockwise.
8. Set Vertical DISPLAY to CHOP A or B.
9. Energize and adjust INTENSITY and FOCUS for clear and just visible sweeps.
10. Set time base TRIGGER LEVEL (main) for stable display.

Figure 3-3. Initial Turn-on Procedure



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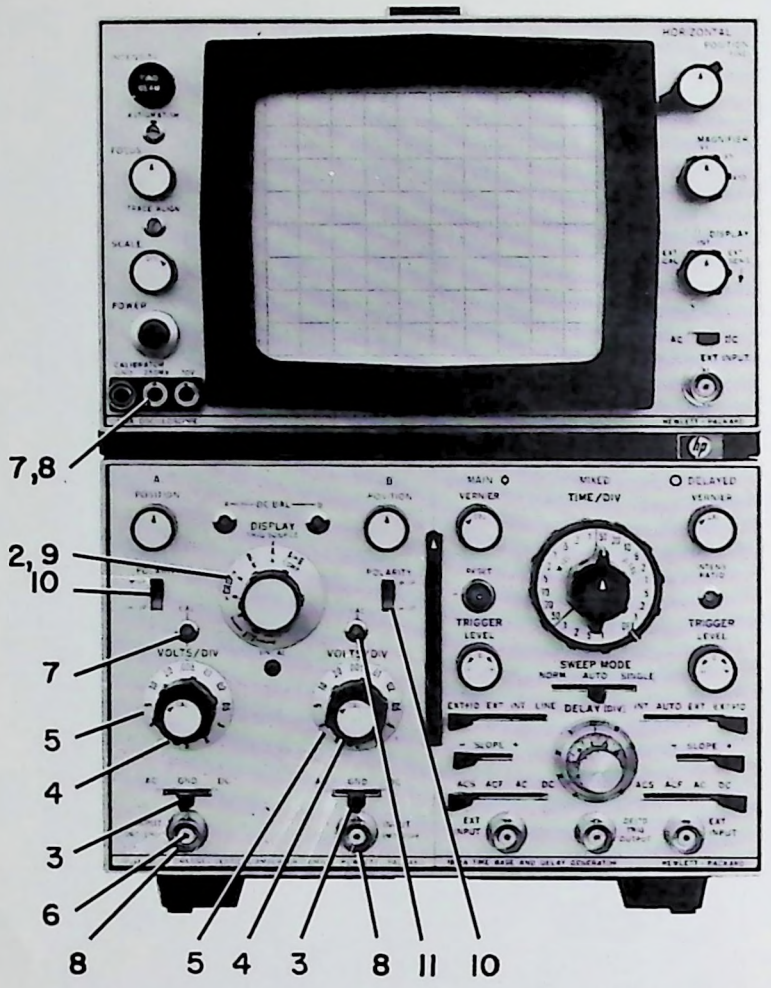
1. Perform initial turn-on procedure in Figure 3-3.

2. Rotate Channel A Vernier from fully clockwise to fully counter-clockwise.

3. If Channel A trace shifts, adjust Channel A DC BAL until trace remains stationary when vernier is rotated to both extremes.

4. Repeat steps 2 and 3 for Channel B.

Figure 3-4. Amplifier Balance Adjustment



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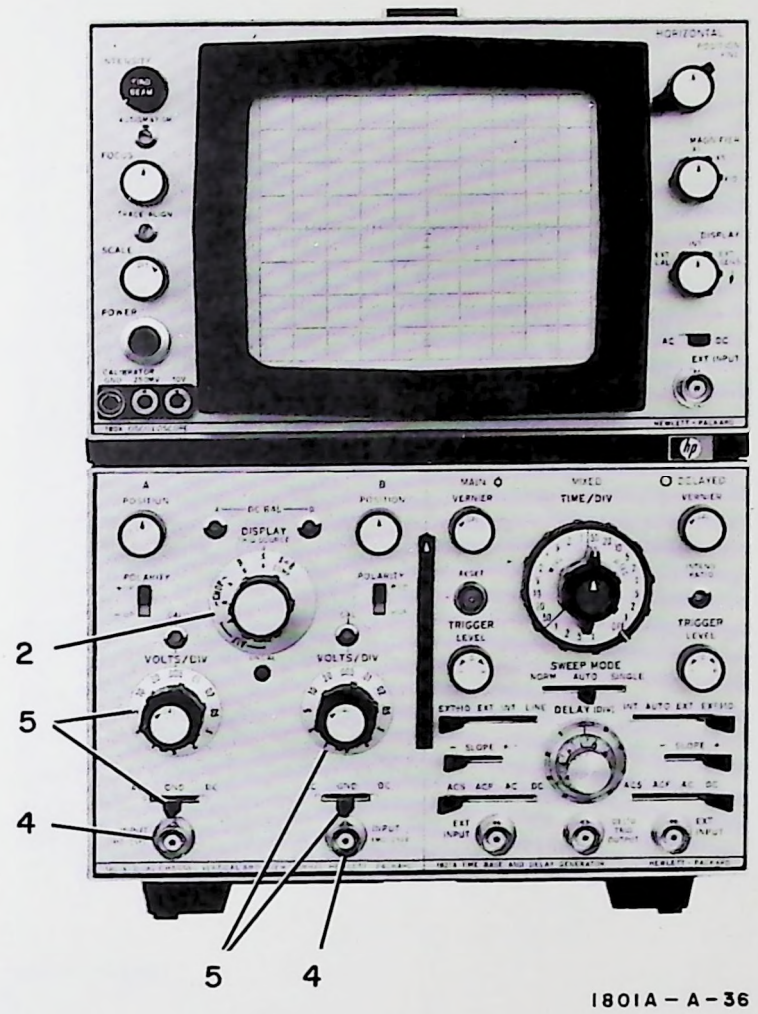
1. Perform amplifier balance adjustment (Figure 3-4).
2. Set Vertical DISPLAY to A.
3. Set A and B Coupling to AC.
4. Set A and B Vernier to CAL.
5. Set A and B VOLTS/DIV to .005.
6. Connect 250 mV signal from CALIBRATOR to A INPUT with 10:1 divider probe.
7. Adjust A CAL for 5 divisions of deflection.
8. Connect 250 mV signal from CALIBRATOR to both A and B INPUT with 10:1 divider probes.
9. Set Vertical DISPLAY to A + B.
10. Set A POLARITY to +UP and B POLARITY to –UP.
11. Adjust B CAL for 0 division of deflection.

Figure 3-5. Amplifier Calibration Adjustment



1. Perform initial turn-on procedure in Figure 3-3.

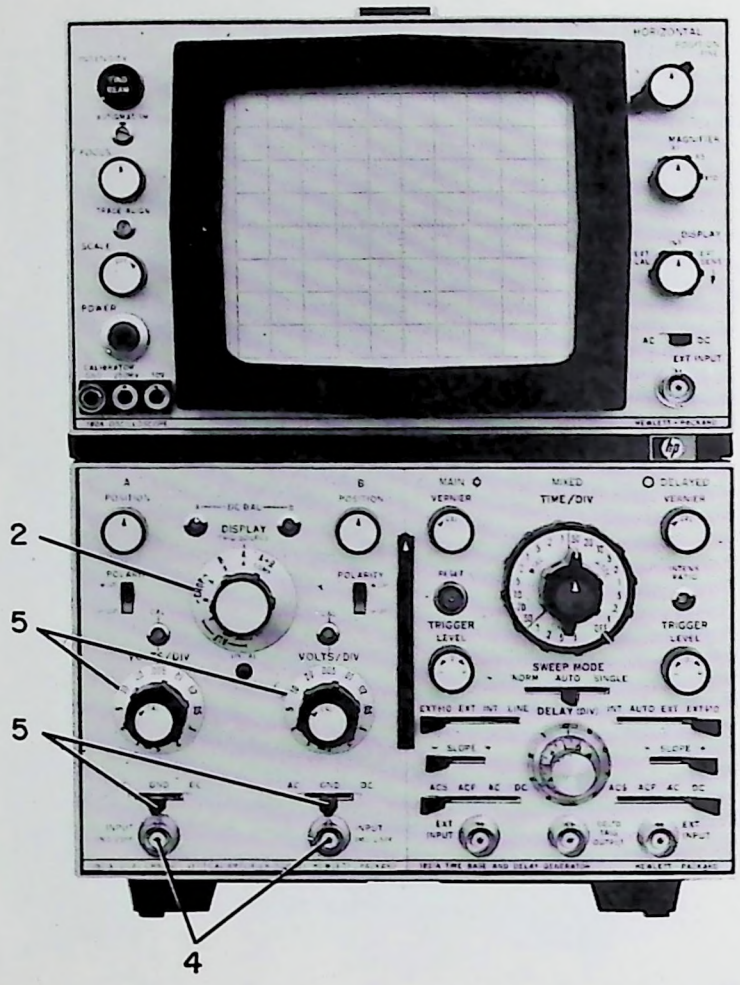
2. Set Vertical DISPLAY to CHOP with either A or B trigger depending on INPUT to be used.

3. During CHOP operation, two signals can be viewed simultaneously on time sharing basis. Use CHOP operation with slow sweep speeds (1 msec/division or slower).

4. Apply signal to one or both INPUT connectors.

5. Set Coupling, VOLTS/DIV, and time base plug-in controls as required.

Figure 3-6. CHOP Mode Operation



1. Perform turn-on procedure in Figure 3-3.

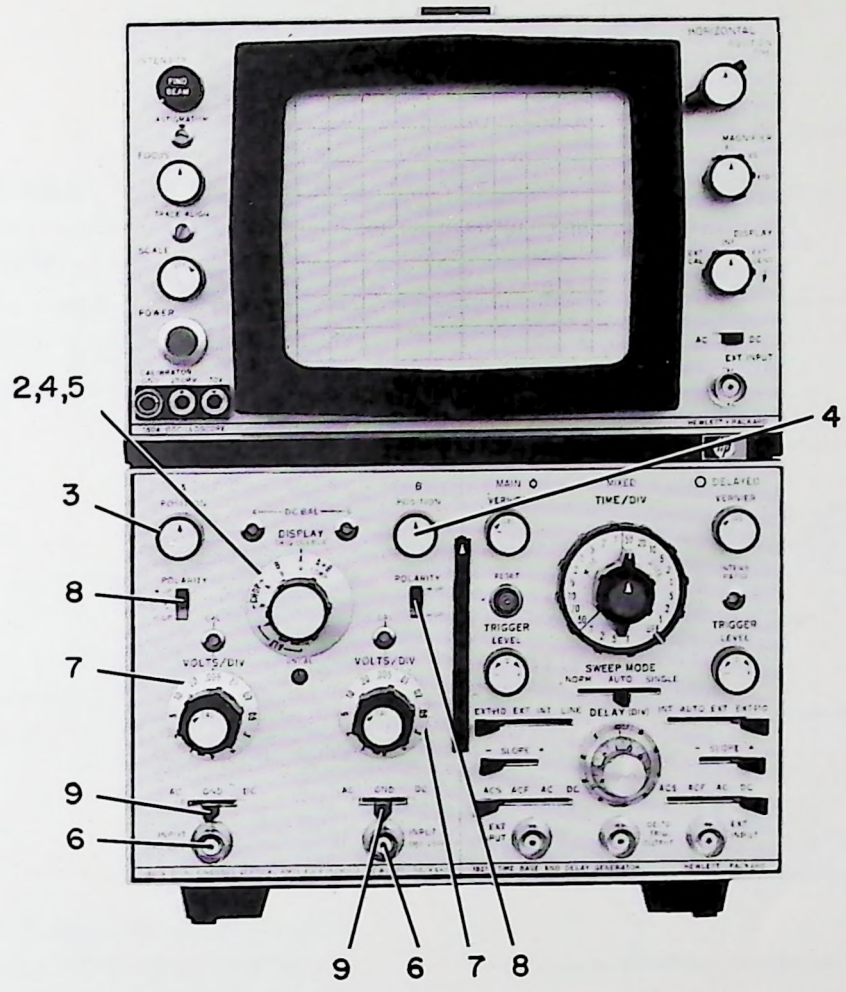
2. Set Vertical DISPLAY to ALT with either A, B, or COMP trigger depending on INPUTS used.

3. During ALT operation, two signals can be seen simultaneously because sweep alternates to display different channel on each sweep. Use ALT operation with fast sweep speeds.

4. Apply signals to one or both INPUT connectors.

5. Set Coupling, VOLTS/DIV, and time base plug-in controls as required.

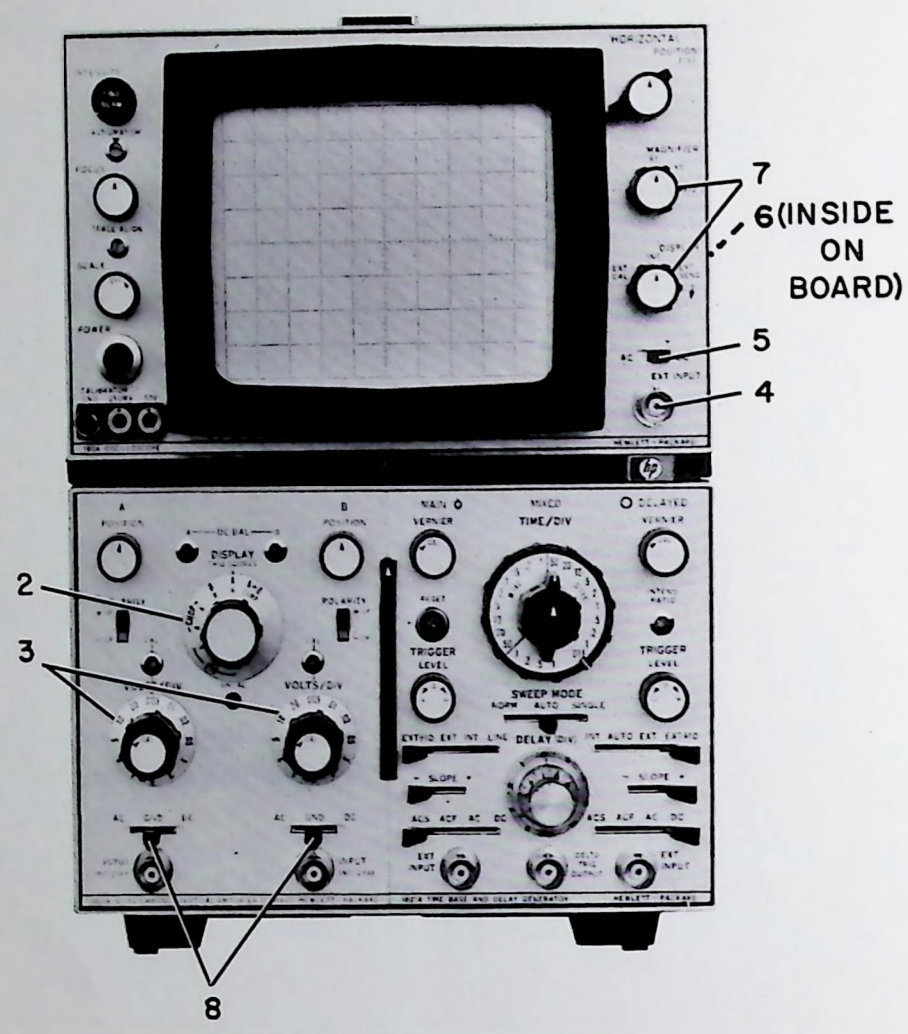
Figure 3-7. ALT Mode Operation



1801A-A-40A

1. Perform initial turn-on procedure in Figure 3-3.
2. Set Vertical DISPLAY to A.
3. Center base line with A POSITION.
4. Repeat steps 2 and 3 for Channel B.
5. Set Vertical DISPLAY to A + B.
6. Connect signals to A and B INPUT.
7. Set VOLTS/DIV as desired.
8. Set POLARITY as desired.
9. Set Coupling as desired.

Figure 3-8. A + B Mode Operation



1801A-A-41

1. Perform initial turn-on procedure in Figure 3-3.

2. Set Vertical DISPLAY to A, B or A + B. For phase measurements use Channel A only.

3. Adjust VOLTS/DIV for desired amount of deflection (both channels if used).

4. Connect horizontal signal to EXT INPUT of oscilloscope.

5. Select horizontal Coupling.

6. If measuring phase relationships, set Phase/Bandwidth switch to Phase (inside top, right cover of oscilloscope).

7. Adjust Horizontal DISPLAY and Horizontal MAGNIFIER for desired amount of deflection.

8. Set Coupling as desired (both channels if used).

NOTE

Return Phase/Bandwidth switch to Bandwidth after making Phase measurements. This will allow normal operation.

Figure 3-9. X-Y Mode Operation

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. Descriptions of basic circuits used in Model 1801A are covered at the beginning of this section. A block diagram, Figure 4-7, with a brief overall functional explanation is given in Paragraphs 4-26 through 4-35. Paragraphs 4-36 through 4-59 contain detailed circuit descriptions (keyed to the Schematics) of the Model 1801A.

4-3. BASIC CIRCUITS.

4-4. The following paragraphs contain information on basic circuits used in the Model 1801A. Use it in conjunction with the information given in the detailed circuit portion of this section. Every attempt has been made to cover most phases of circuit operation, and give a better understanding of this instrument.

4-5. ATTENUATOR.

4-6. An attenuator network is a frequency compensated voltage divider that is used to control the input voltage to an amplifier. A simple resistance attenuator is shown in Figure 4-1 A. The output is related to the input by the ratio of R2 to the sum of R1 plus R2. In Figure 4-1, voltage out is equal to one tenth voltage in and is independent of frequency.

4-7. The circuit in Figure 4-1 B includes capacitance made up of the input and stray wiring capacitances. The simple voltage division relationship between input and output is no longer frequency independent. To correct this, R1 is shunted by a compensating capacitance C2. The network then becomes an RC bridge, and is balanced when R1C2 = R2C3 (Figure 4-1 C). Figure 4-1 C shows a circuit that the relationship of input to output voltage is again frequency independent.

4-8. Variations in input time constants of different attenuator sections can be corrected by placing a variable capacitance at the input terminals. The input RC then becomes:

$$\text{INPUT (RC)} = \left(C1 + C_{STRAY} + \frac{C3\,C2}{C3 + C2}\right)(R_{IN}).$$

4-9. IMPEDANCE CONVERTER.

4-10. The primary function of an impedance converter, Figure 4-2, is to provide high input impedance and low output impedance. The source follower Q1 provides high input impedance (due to high input impedance of a FET) while the emitter follower Q2 provides low output impedance.

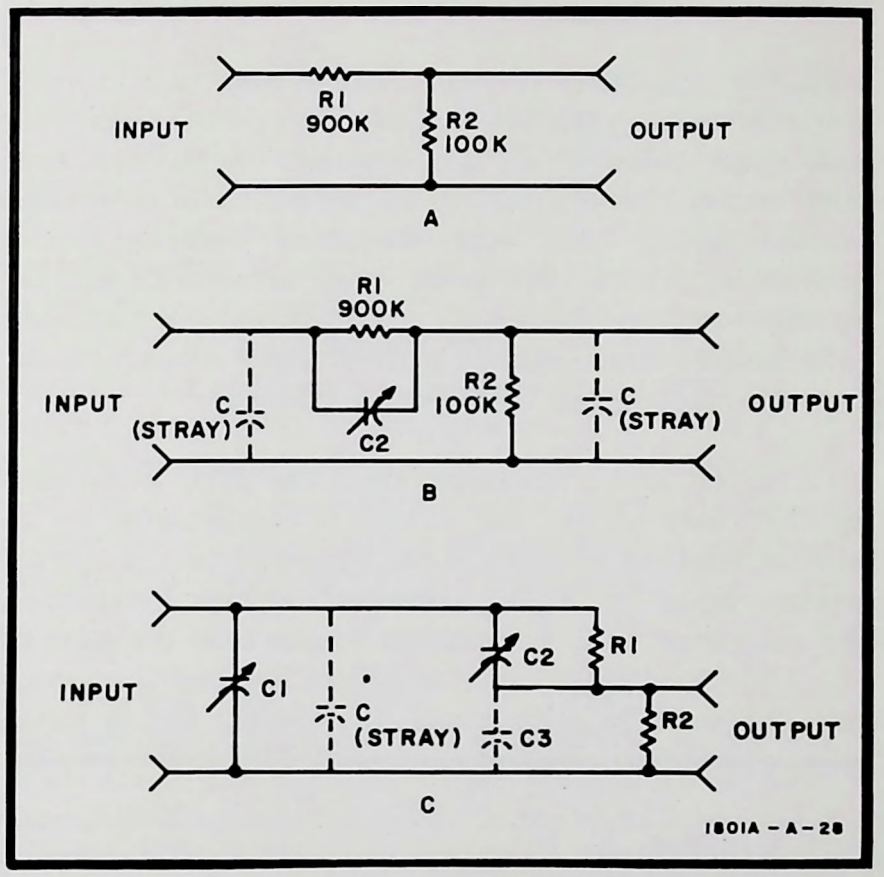


Figure 4-1. Basic Attenuator

4-11. Since input resistance of an impedance converter is > 100 megohms, the input resistance is set by the 1 megohm resistor placed from gate to ground. (1 megohm in parallel with 100 megohm is within one percent of 1 megohm). This provides a known constant value of input resistance from which attenuator accuracy is based.

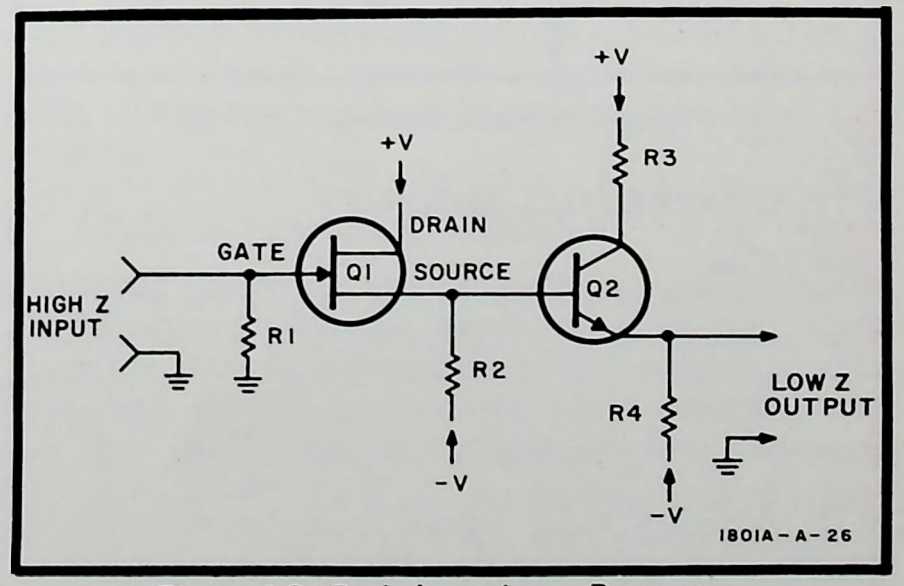


Figure 4-2. Basic Impedance Converter

4-12. CASCODE AMPLIFIER.

4-13. A basic cascode amplifier is shown in Figure 4-3. It consists of a common base stage (Q2) driven by a common emitter stage (Q1). This combination makes it possible to achieve frequency response and gain necessary for wide band operation.

4-14. High frequency response is restricted primarily by signal source impedance and Miller effect of Q1. In a voltage amplifier, Miller effect causes collector-to-base capacitance to increase with voltage gain. Since capacitive reactance of Cob decreases as frequency increases, a large negative feedback is coupled from collector-to-base. Thus, high frequency response is much less than low frequency response.

4-15. By operating Q1 as a low voltage gain, current amplifier driving the low impedance input of a common base stage, Miller effect is minimized. The common base stage also acts as a current-to-voltage converter to increase over-all voltage gain. High frequency response is now limited by source impedance, stray capacitance and Q1 collector-to-base capacitance. Also, bandwidth is maximum when source impedance of external signal is much smaller than the reactance of Q1 at high frequencies.

4-16. Since gain of a cascode amplifier tends to decrease at high frequencies, the circuit is compensated by an emitter peaking network. Low frequency gain is approximately equal to R_L/R_e. However, at high frequencies, the reactance of C2 diminishes to less than the value of R_e. Thus, emitter impedance is less and high frequency gain increases to compensate for inherent circuit losses.

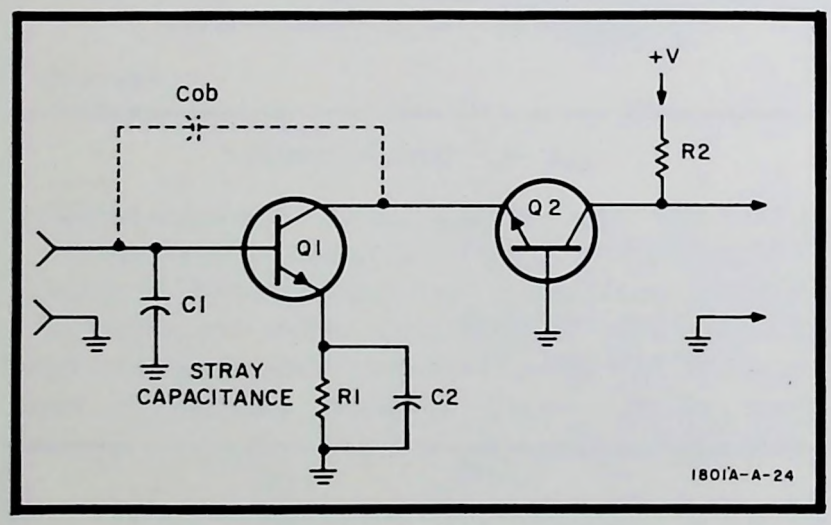


Figure 4-3. Basic Cascode Amplifier

4-17. DIFFERENTIAL AMPLIFIER.

4-18. Figure 4-4 shows a basic differential amplifier. Only out-of-phase (difference) signals are amplified by this circuit. In-phase waveforms applied to both inputs are called common mode signals. These, often in the form of unwanted noise and stray pick-up, are rejected.

4-19. Different input signals cause one transistor to increase conduction and the other to decrease conduction. Since the output is taken across the two collectors, input signals are amplified and voltage drops across R2 and R3 are summed.

4-20. When common-mode signals are applied, both transistors either increase or decrease conduction and do not cause opposite current changes through R2 and R3. Thus, no output is developed, and the output is always the amplified difference between the two input signals.

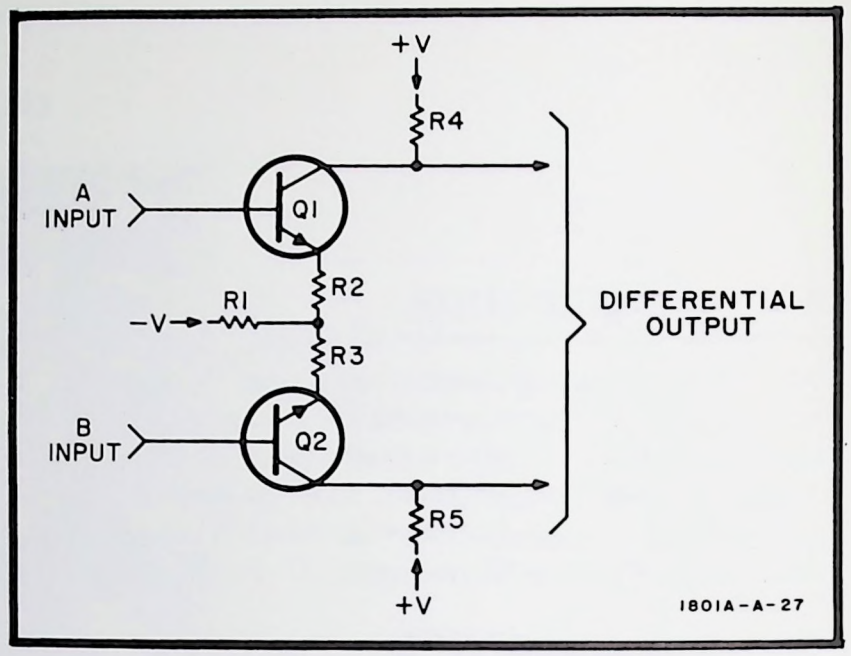


Figure 4-4. Basic Differential Amplifier

4-21. BISTABLE MULTIVIBRATOR.

4-22. Figure 4-5 shows a basic bistable multivibrator. The multivibrator is switched by applying a negative trigger to steering diodes CR1 and CR2. Assume Q1 is saturated and Q2 is off. For this condition, the base of Q1 will be approximately −0.6V, while the base of Q2 will be appreciably more positive. When a negative trigger arrives, CR2, steering diode for the off transistor, is turned on since its anode is at a higher potential than CR1. When CR2 is turned on by the negative trigger, the base of the off transistor (Q2) is steered to a negative potential. If the trigger is more negative than −1.2 volts, Q2 will start conducting and, providing there is sufficient regeneration, the multivibrator will change states. It will stay in this new stable state until the next trigger arrives.

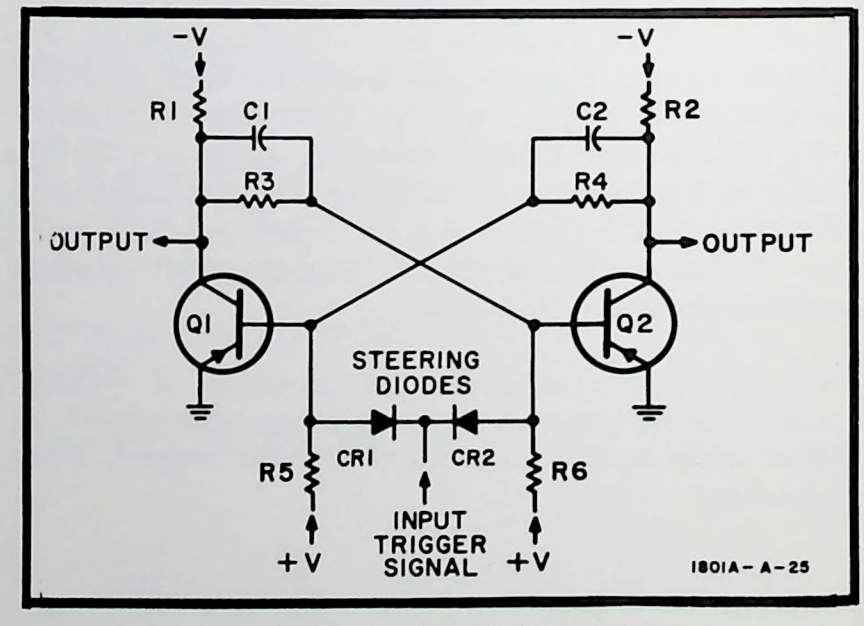


Figure 4-5. Basic Bistable Multivibrator

4-23. COMPLEMENTARY EMITTER FOLLOWER.

4-24. A complementary emitter follower provides a low output impedance for both positive and negative pulses. For a single emitter follower circuit, depending on the type (npn or pnp), the output impedance is low for either a positive or a negative pulse, but not both.

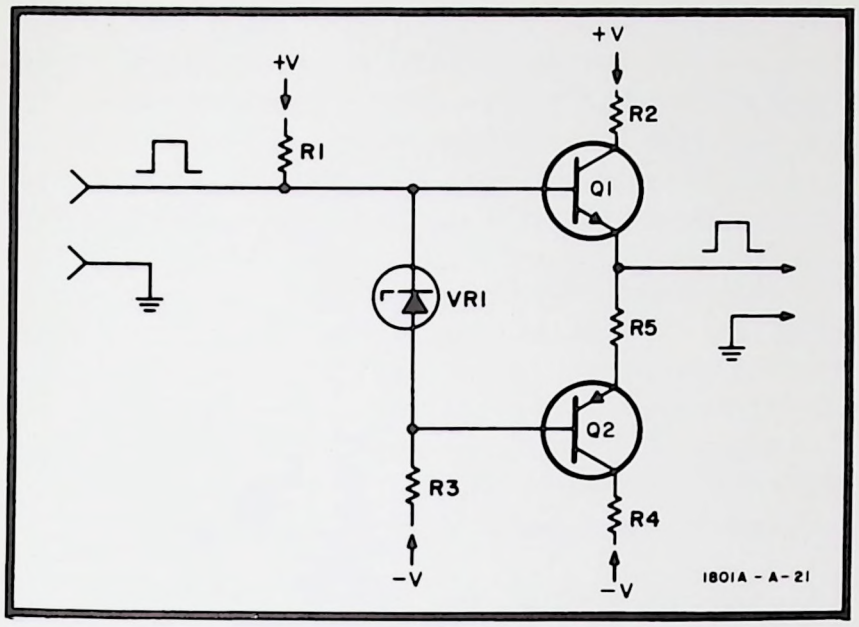


Figure 4-6. Basic Complementary Emitter Follower

4-25. The circuit shown in Figure 4-6 is a basic complementary emitter follower. The npn transistor (Q1) provides the low output impedance for a positive pulse where the pnp transistor (Q2) provides the low output impedance for a negative pulse. Cross-over distortion is minimized by biasing both transistors on during quiescence.

4-26. FUNCTIONAL DESCRIPTION.

4-27. The input signals to Channel A and B are applied through the coupling switches to the attenuators. The signals are attenuated on all but the lowest setting of each VOLTS/DIV switch, and applied to impedance converters. Signals from the converters are applied to the first differential cascode amplifier where they are converted to differential signals, amplified, and directed to the channel gates. The gates turn either channel on or off or turn both channels on at the same time. The signal that is coupled through the gates is directed through the delay line where it is delayed 162 ns. The delay line delays the vertical signal until after the horizontal sweep starts. This makes it possible to observe the leading edge of fast risetime pulses. The delayed signal is amplified in the main amplifier to drive the CRT vertical deflection plates.

4-28. A OR B.

4-29. When single channel operation is selected (A or B), the multivibrator turns on the gate of the selected channel and turns off the gate of the other channel. The input signal for the selected channel, either Channel A or Channel B, is then coupled through the channel gate into the delay line and main vertical amplifier to the CRT vertical deflection plates. It is also applied to the sync amplifier where it is converted to a single-ended signal and amplified. From the sync amplifier, it is coupled to the plug-in where it is used for horizontal synchronization.

4-30. A + B.

4-31. Positioning the DISPLAY switch to A + B biases both sides of the multivibrator to the same state; turning both channels on. The input signals to both channels are algebraically summed and the resultant signal (composite) is coupled through the delay line and main amplifier to the vertical deflection plates. As in single channel operation, the composite signal (from the gates) is applied to the sync amplifier and used to trigger the sweep.

4-32. CHOP.

4-33. When the DISPLAY switch is set to CHOP, the multivibrator is biased to its astable condition where it will free-run at a frequency of 400 kHz. During each horizontal sweep, the gates are alternately switched on for 1.25 usec. The resulting signal (1.25 usec of one input, then 1.25 usec of the other) is coupled through the delay line and the main amplifier to the CRT deflection plates. Each time the multivibrator changes state, the gate switches, and a positive pulse (called chopped blanking) is generated and applied to the gate amplifier in the HP 180-series oscilloscope. This amplified pulse turns the CRT off so that the switching transients will not be displayed. The sync signal supplied to the sync amplifier is obtained from either Channel A, or Channel B amplifier.

4-34. ALT.

4-35. Selecting ALT with the DISPLAY switch biases the multivibrator for bistable operation. At the end of each sweep, the alternate trigger pulse from HP 180-series oscilloscope sets the multivibrator to its other state. Thus, each input channel is alternately on for one complete sweep. When operating in the ALT mode, the on channel signal is coupled to the sync amplifier. The sync signal supplied to the sync amplifier is obtained from Channel A, B, or main amplifier (composite sync).

4-36. CIRCUIT DETAILS.

4-37. The following paragraphs provide a detailed explanation of the individual circuits in the Model 1801A. Circuits that are identical for both channels are explained for Channel A only.

4-38. ATTENUATOR. (See Schematic 1.)

4-39. The Model 1801A features a two-section, constant input impedance attenuator, consisting of four switchable decade dividers in series with three switchable binary dividers. The first section has division ratios of 1:1, 10:1, 100:1, and 1000:1; and the binary section has ratios of 1:1, 2:1 and 4:1. The most sensitive position of the VOLTS/DIV switch (.005) utilizes the 1:1 divider of both sections; the second most sensitive position utilizes the 1:1 divider of the first section and the 2:1 divider of the second section, etc. Each divider in the first section is used, in turn, with each divider in the second section, providing 12 possible ranges. The attenuator circuit maintains the desired 1 megohm shunted by 25 pF input impedance and also provide the required voltage division.

4-40. The input capacitance of A3Q1 and the stray wiring capacitance are present on all attenuator ranges. These

capacitances along with each attenuator input capacitance determine the input C of the instrument. For the Model 1801A, the input capacity for all ranges is set to approximately 25 pF.

4-41. In the most sensitive range (.005 position of the VOLTS/DIV switch), A1C2, A1R13, the stray wiring capacitance, and the input capacitance of A3Q1 determine the input impedance. In the .01 VOLTS/DIV position, A1R9, in series with parallel resistance of A1R13 and A1R10, determines input resistance and voltage division. The value of A1C17 in parallel with A1C18 provides high frequency compensation. The value of A1C15, in parallel with A1C16, multiplied by input resistance of the .01 range ensures the same input time constant from range to range. In the .05 position, input resistance and voltage division are determined by series resistor A1R2 and the parallel value of A1R3 and A1R13. A1C6 adjusts the high frequency compensation. The input time constant is established by adjustment A1C3 in parallel with A1C4. The input impedance and voltage division for remaining attenuator ranges are determined in the same manner. Field effect transistor, A3Q1, is a source follower having a very high gate input resistance, and has little effect on the resistive operation of the attenuator. (The parallel combination of the 1 megohm resistor A1R13 and the high input impedance of A3Q1 is nearly 1 megohm.)

4-42. INPUT IMPEDANCE CONVERTER. (See Schematic 1).

4-43. The signal voltage from the attenuator is applied to an impedance converter consisting of A3Q1 and A3U1Q1. A3Q2 and A3U1Q2 are connected as source and emitter followers respectively to provide temperature compensation for A3Q1 and A3U1Q1. Additional temperature compensation is achieved by using a common heatsink for A3Q1 and A3Q2, and the monolithic device A3U1 for A3U1Q1 and A3U1Q2. Protection against excessive signal input to A3Q1 is provided by A3R1, A3R2, and A3CR2. The reverse current flow through A3CR2, although small, is compensated for by A3CR1. A3R1 limits the gate current while A3C1 ensures that there will be no loss of high frequency signal components. R1 provides a balance adjust for the stage driving the polarity gates.

4-44. INPUT AMPLIFIER. (See Schematic 2).

4-45. The signal from the emitter of A3U1Q1 is applied to differential cascode amplifier A3Q5/Q7 and A3Q6/Q8. The single-ended signal is converted to a differential signal by cross-coupling A3Q5 and A3Q6 emitter current through A3R18. The differential signal current flows into emitters of A3Q7 and Q8. Overall gain of the cascode amplifier is controlled by R3 (CAL) and A1R14 (VERNIER) which shunt current from the emitters of A3Q7 and Q8. Differences in base-to-emitter voltage drops of A3Q7 and Q8 are compensated by adjusting A3R25. To eliminate variation of the dc output level when an amplification change is encountered, recalibrate A1R14 and/or R3.

4-46. Polarity diode gates are used to select +UP or −UP (inverting) of the Model 1801A input signal. Signal polarity is selected by POLARITY selection switch, S2. Selecting +UP turns on A3CR9-12, coupling the signal from A3Q9 to A3Q11 and from A3Q10 to A3Q12. When −UP is selected A3CR5-8 are turned on, coupling output of A3Q9 to A3Q12 and output of A3Q10 to A3Q11. A portion of signal at emitter of A3Q9 is used for synchronizing the vertical and horizontal signals. (The sync amplifier circuit will be discussed later). The front-panel POSITION control (R4) establishes the relative voltages at the base of A3Q11 and A3Q12, determining vertical position of the trace on the CRT. This stage is frequency compensated by emitter circuits of A3Q11 and A3Q12.

4-47. Channel selection and switching is performed by channel diode gates. Operating voltages for the gates are obtained from a multivibrator, which is controlled by the front-panel DISPLAY switch. A negative output voltage from the multivibrator causes A3CR14 and CR16 to conduct and A3CR13 and CR15 to stop conducting thus, Channel A signals are passed on for further amplification and display. A positive voltage from the multivibrator supplies enough current through A3CR13 and CR15 to back bias A3CR14 and CR16. This in turn blocks the channel signal from entering the main amplifier. In the A + B mode, both channels are turned on by applying a negative voltage to anode of A3CR13, CR15, CR25, and CR27 causing them to be backed biased. This couples the two signals to the main amplifier. Resistor A3R54 balances the gate current flowing through delay line DL1. A portion of the differential signal from output of channel diode gates is applied to the sync amplifier.

4-48. MAIN AMPLIFIER. (See Schematic 3).

4-49. Differential signals from channel selector diode gates are delayed 162 ns by delay line DL1 and applied to current summing amplifiers A3Q21 and Q22. The signal is amplified by A3Q23 and Q24 and coupled to the first half of output differential cascode amplifier. Output of this amplifier then drives the CRT's vertical deflection plates.

4-50. BEAM FINDER. (See Schematic 3).

4-51. Current for operation of the cascode amplifier flows through the normally closed contacts of the FIND BEAM switch located on the front panel of the 180-series oscilloscope. When this switch is pressed, the contacts are opened and current source тor the amplifier is reduced by R7 and limits the vertical excursion of the CRT beam so that it is on-screen.

4-52. MULTIVIBRATOR. (See Schematic 4).

4-53. Operation of multivibrator A4Q1/Q2 is controlled by DISPLAY switch, S1. Outputs are applied through emitter follower A4Q3/Q4 to the Channel A and B diode gates.

4-54. When the DISPLAY switch is set to ALT, the multivibrator is bistable. Connecting +15V-supply to A4R9 and A4R11 causes the negative-going alternate trigger signal to be generated by the HP 180-series oscilloscope after each sweep. These pulses are coupled to bases of A4Q1 and Q2 through steering diodes A4CR3 and CR4. Each trigger pulse turns on the nonconducting transistor, switching the multivibrator to its other state. Each channel is alternately switched on for one complete sweep.

4-55. In CHOP mode of operation, the multivibrator is made astable by applying −12.6V through A4R9 and A4R11, and +15V through A4R12. Diodes A4CR3 and CR4 are biased off, blocking the alternate trigger signal, permitting the multivibrator to switch the channels on and off at a 400-kHz rate.

4-56. Selecting Channel A, Channel B, or A + B (both channels) sets the multivibrator to a fixed state. Table 4-1 provides details of the multivibrator state and voltage output for each of these selected operating modes. A positive voltage permits the channel diode gate to short the amplifier signal and disconnects that channel, resulting in no display signal from that channel.

Table 4-1. Multivibrator Status and Output

Display Selected	Multivibrator State		Output voltage to Channel Diode Gates	
	A4Q1	A4Q2	A	B
A	OFF	ON	−	+
B	ON	OFF	+	−
A+B	OFF	OFF	−	−

4-57. In CHOP mode of operation, the square-wave signal from A4Q3 and A4Q4 is differentiated by A4C9/R17 and A4C10/R18. The positive-going voltage pulses are detected by A4CR7 and CR8. The positive-going signal is applied to emitter follower A4Q5 and to the HP 180-series oscilloscope CRT blanking circuitry, resulting in CRT trace blanking during channel switching.

4-58. SYNC AMPLIFIER.

4.59. A deflection signal from Channel A, Channel B, or the composite signal from the input of the main amplifier may be selected for sync generation. The three signal sources are taken from the input amplifier.

4-60. The input of the sync amplifier assembly, A5, contains three sync amplifier circuits: one for Channel A, one for Channel B, and one for the composite sync signal. Since the three sync amplifiers are nearly identical, only the composite sync amplifier will be described.

4-61. A5Q1/A5Q2 is enabled when front-panel DISPLAY switch S1 is set for either of the composite display modes (A + B or ALT COMP). The differential channel gate outputs from Channels A and B provide the inputs to A5Q1/Q2. The composite sync amplifier adds the differential inputs and provides a single-ended composite output which is applied to common-base amplifier A5Q3. In all other positions of DISPLAY switch S1, resistor A5R24 is grounded, reverse biasing the composite sync amplifier. The only difference between the Channel A and Channel B sync amplifiers and the composite sync amplifier is A5R22, which allows trigger level adjustment in composite display modes.

4-62. Common-base amplifier A5Q3, combined with the selected sync amplifier, forms a cascode amplifier. This circuit exhibits the general characteristics of a cascode amplifier with the added stability of a differential input.

4-63. The feedback amplifier A5Q3 output is applied to the input of feedback amplifier A5Q4/A5Q5/A5Q6. The sync signal is amplified by A5Q4 and A5Q6 with positive feedback to the base of A5Q5. Transistors A5Q4 and A5Q5 form a differential amplifier with transistor A5Q4 accepting the main signal input and A5Q5 accepting the feedback input. The feedback amplifier has a gain of 10 and a wide bandwidth for trigger stability. A5R33 sets the gain of the feedback amplifier to allow dc level adjustment of the internal trigger signal.

4-64. When front-panel DISPLAY switch S1 is set to either of the CHOP modes, A5R44 is grounded. This forward biases diode A5CR1. With A5CR1 conducting, A5C13 is connected in series with A5C12 to form a low-pass filter. The filter decreases sync amplifier bandwidth to prevent triggering on any transients produced during channel switching.

4-65. The output of the complementary feedback amplifier is applied to complementary emitter follower A5Q7/A5Q8. Diodes A5VR3 and A5VR4 set the bias level so that both A5Q7 and A5Q8 are on. Transistor A5Q7 amplifies the positive portion of the sync signal while A5Q8 amplifies the negative portion. The output of the complementary emitter follower is applied to J3 which couples the low impedance internal sync signal to the time base plug-in.

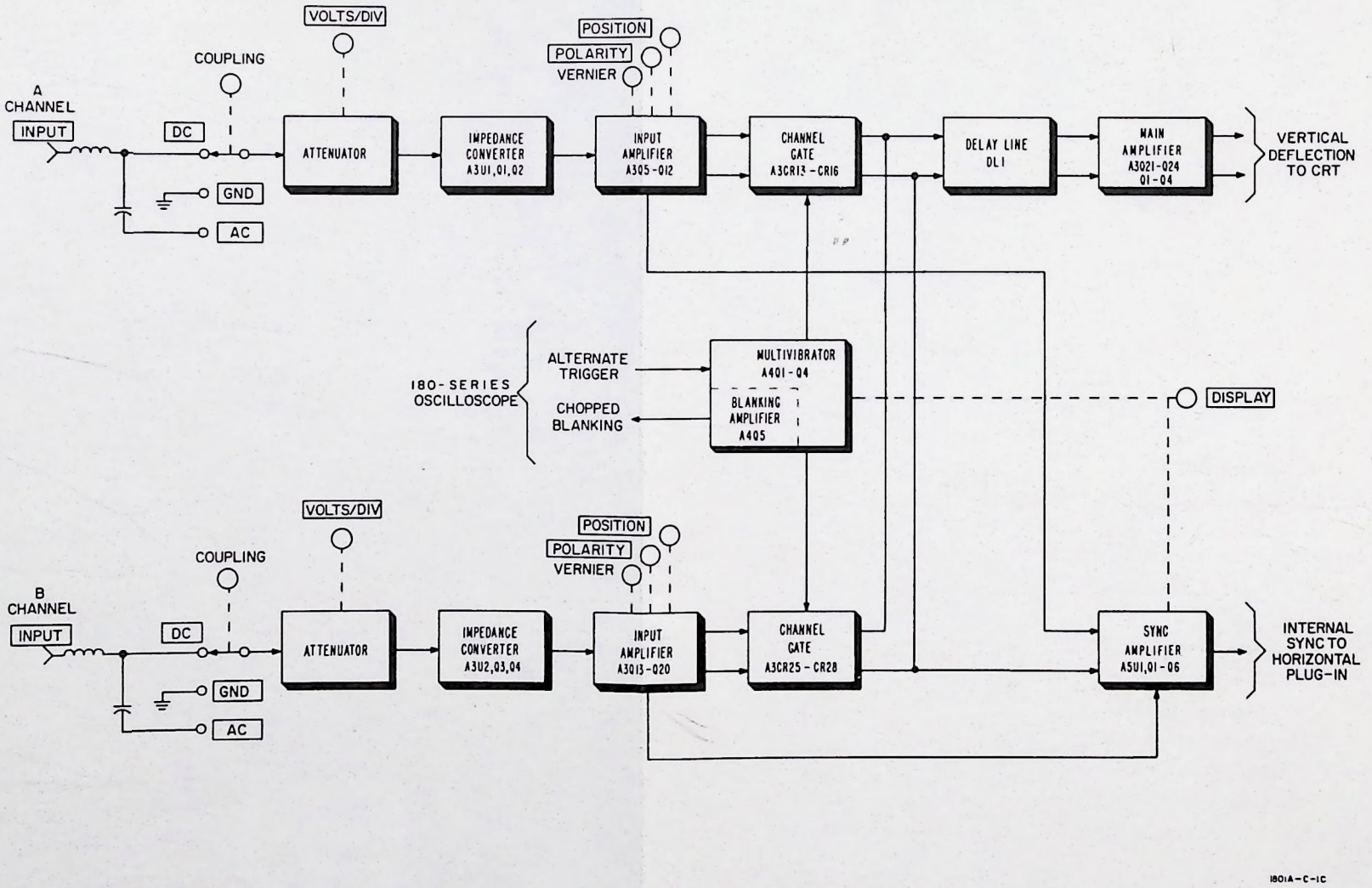


Figure 4-7. Over-all Block Diagram

Table 5-1. Required Test Equipment

Recommended Instrument		Required Characteristics	Para. Ref.
Type	Model		
Voltmeter Calibrator	HP Model 738AR, H01-738BR	30mV-10V pk-pk 0.2% accuracy	5-12 5-13 5-26
Constant Amplitude Signal Generator	Tektronix Type 191	50 kHz-50 MHz @ 4V pk-pk	5-14 5-15 5-16
RF Voltmeter	HP Model 411A	50 kHz-50 MHz 3% accuracy	5-15
Oscillator	HP Model 200CD	100 kHz @ 1V pk-pk	5-16
Pulse Generator	HP ET2266	Risetime ≤1.5 nsec Amplitude ≥0.5 V Overshoot and Ringing <2% Pulse Width >1 usec Pertubation <1%	5-17 5-29
DC Voltmeter	HP Model 412A	5 mV-10 Vdc	5-25
Plug-in Extender	HP Model 10407A/B		5-27
Square Wave Generator	HP Model 211A/B	Risetime ≤20 nsec 60 mV-30 V	5-27
LC Meter	HP 4332A	20-50 pF 3% accuracy	5-28

Accessories Required:

(1) 50-ohm feed through termination HP Model 10100A
(1) Tee Connector UG-294B/U

SECTION V

PERFORMANCE CHECK AND ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section contains the performance check and the adjustment procedure for Model 1801A. Troubleshooting information, Schematics and component identification figures are located in Section VIII.

5-3. TEST EQUIPMENT.

5-4. Test equipment required for maintaining and checking the performance of the Model 1801A is listed in Table 5-1. Test equipment having characteristics similar to those listed in the table may be used for the performance check and adjustment. Use a non-metallic alignment tool for making the required adjustments.

5-5. PERFORMANCE CHECK.

5-6. The performance check verifies whether or not the Model 1801A is operating within specifications stated in Table 1-1. Use this check as part of an incoming quality control inspection, as a periodic operational check, or after repairs and/or adjustments have been made. Use recently calibrated test equipment when performing this check.

5-7. A Performance Check Record is included in the manual on Page 5-4a/5-4b. As the initial performance check is accomplished, enter the results on the Performance Check Record. Remove the record from the manual and file it in a safe place so checks made at a later date can be compared with the original results.

5-8. Accomplish the performance check in the sequence given below. Do not attempt to start procedure in mid-sequence, because succeeding steps are dependent on control settings and results of previous steps.

5-9. PRELIMINARY SETUP.

5-10. Lock plug-ins together and install in 180-series oscilloscope. Apply power and allow a 15-minute warm-up. Perform Amplifier Balance Adjustment, Figure 3-4, and Amplifier Calibration Adjustment, Figure 3-5, before beginning performance check.

5-11. INITIAL CONTROL SETTINGS.

a. Set HP 180-series oscilloscope controls:

Horizontal Magnifier	X1
Horizontal Display	Internal

b. Set Model 1801A controls:

DISPLAY	A
A and B POLARITY	+UP
A and B Vernier	CAL
A and B VOLTS/DIV	.005
A and B coupling	AC

c. Set time base controls (as applicable):

Sweep Display	MAIN SWEEP
Sweep Mode	AUTO SWEEP
Main Trigger Source	Internal
Main Slope	+ (positive)
Main Trigger Coupling	ac
Main Sweep Time	1 msec/div
Delayed Sweep Time	off

5-12. DEFLECTION FACTOR.

a. Connect 400-Hz signal from Voltmeter Calibrator output to Channel A INPUT (Channel B INPUT).

b. Set Voltmeter calibrator output and Channel A VOLTS/DIV (Channel B VOLTS/DIV) according to Table 5-2.

c. Adjust time base Main Trigger Level for stable display.

d. Observe vertical deflection specified in Table 5-2.

Table 5-2. Deflection Factor Accuracy

Voltmeter Calibrator Volts (pk-pk)	VOLTS/DIV	Display Height (div)
.03	.005	6±0.18
.05	.01	5±0.15
.1	.02	5±0.15
.3	.05	6±0.18
.5	.1	5±0.15
1	.2	5±0.15
3	.5	6±0.18
5	1	5±0.15
10	2	5±0.15
30	5	6±0.18
50	10	5±0.15
100	20	5±0.15

e. Switch Model 1801A Vertical DISPLAY to B.

NOTE

Use an attenuator or voltage divider with some signal sources to reduce signal to noise ratio. Attenuators with 20 dB (10:1) or 40 dB (100:1) of attenuation with greater than 1% accuracy are satisfactory.

f. Repeat steps a through d for Channel B.

g. If all results are incorrect perform adjustment procedure. If part of the results are incorrect refer to Section VIII for troubleshooting information.

5-13. VERNIER.

a. Rotate Channel B Vernier fully ccw. Observe vertical display of less than 2 div.

b. Set Vertical DISPLAY to A.

c. Connect Voltmeter Calibrator output to Channel A INPUT.

d. Rotate Channel A Vernier fully ccw. Observe vertical display of less than 2 div.

e. Disconnect Voltmeter Calibrator.

f. If results are incorrect perform adjustment procedure.

5-14. COMMON-MODE REJECTION.

a. Set Model 1801A controls:

A and B VOLTS/DIV	0.05
A and B Vernier	CAL
A and B coupling	GND

b. Connect Constant Amplitude Signal Generator output to Channel A and B INPUT. Adjust frequency for 1-MHz.

c. Set Model 1801A Channel A Coupling to DC.

d. Adjust Constant Amplitude Signal Generator for 2 div display.

e. Adjust Channel A POSITION to center baseline.

f. Set Vertical DISPLAY to B.

g. Adjust Channel B POSITION to center baseline exactly.

h. Set Model 1801A controls:

DISPLAY	A + B
B POLARITY	−20
A and B VOLTS/DIV	.005
B coupling	DC

i. Observe vertical display of less than 0.2 div.

NOTE

A or B Verniers may be adjusted to obtain less than 0.2 div of deflection.

j. If results are incorrect perform adjustment procedure.

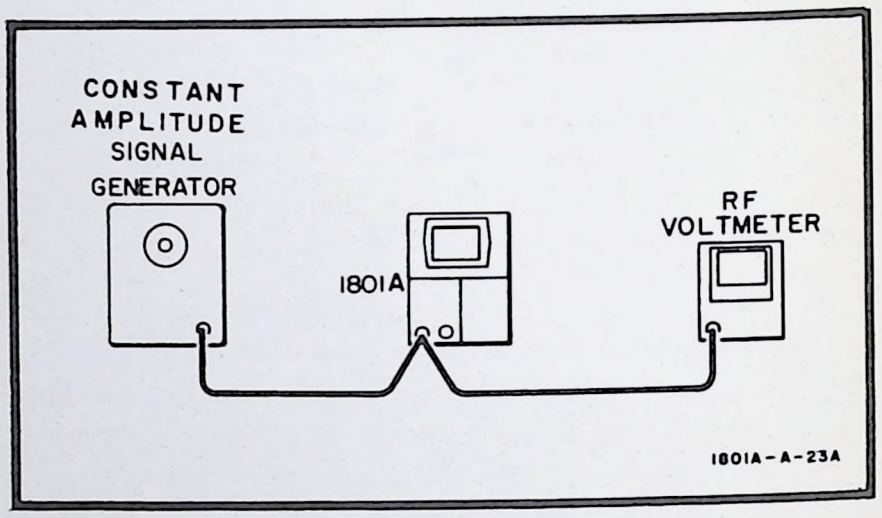


Figure 5-1. Channel A Bandwidth Test Set-up

5-15. BANDWIDTH.

a. Set Model 1801A controls:

DISPLAY	A
Channel B POLARITY	+ UP
A and B VOLTS/DIV	.5
A and B Vernier	CAL

b. Connect Constant Amplitude Signal Generator output and RF Voltmeter input to Channel A INPUT as shown in Figure 5-1.

c. Adjust Constant Amplitude Signal Generator for 50-kHz signal.

d. Adjust Constant Amplitude Signal Generator for 8 div. display and note voltage level with RF Voltmeter.

e. Adjust Constant Amplitude Signal Generator for 50 MHz signal.

f. Adjust Constant Amplitude Signal Generator for same voltage indication as noted in step d. Observe more than 5.7 div of vertical deflection on CRT.

g. Connect Constant Amplitude Signal Generator output and RF Voltmeter input to Channel B INPUT as shown in Figure 5-2.

h. Set Vertical DISPLAY to B.

i. Repeat steps c through f.

j. If results are incorrect perform adjustment procedure.

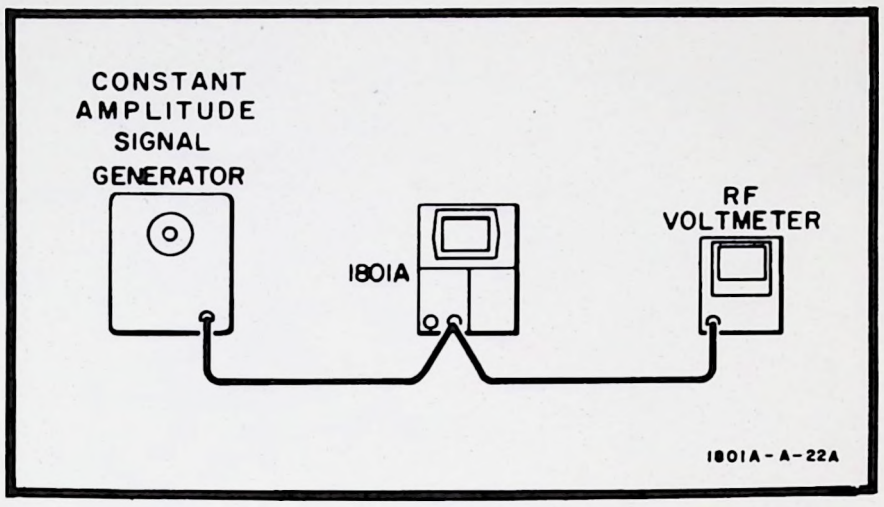


Figure 5-2. Channel B Bandwidth Test Set-up

5-16. TRIGGERING.

a. Set time base sweep time to 0.1 usec.

b. Set Model 1801A Channel B VOLTS/DIV (Channel A VOLTS/DIV) to .05.

c. Adjust Constant Amplitude Signal Generator for a 50 Mhz output (0.5 div of vertical deflection).

d. Adjust time base Main Trigger Level for stable display.

e. Disconnect Constant Amplitude Signal Generator.

f. Connect Oscillator output to Channel B INPUT (Channel A INPUT) and adjust Oscillator for 1 kHz signal.

g. Set time base main sweep time for 1 msec/div.

h. Set Model 1801A Channel B VOLTS/DIV (Channel A VOLTS/DIV) to 5 and DISPLAY to CHOP.

i. Adjust Oscillator output amplitude for 0.5 div of vertical deflection.

j. Adjust time base Main Trigger Level for stable display.

k. Disconnect Oscillator.

l. Set Vertical DISPLAY to A.

m. Connect Constant Amplitude Signal Generator to Channel A INPUT.

n. Repeat steps a through k.

o. If results are incorrect perform adjustment procedure.

5-17. RISETIME.

a. Set HP 180-series oscilloscope Horizontal Magnifier to X10.

b. Set time base Main sweep time to 0.1 usec/div.

c. Set Model 1801A Channel A and B VOLTS/DIV to .005 (or as necessary).

d. Connect Pulse Generator output to Channel A INPUT (Channel B INPUT) using 50-ohm termination.

e. Set Pulse Generator for 8 div pulse.

f. Adjust time base Main Trigger Level for stable display.

g. Adjust Horizontal Position to observe leading edge of pulse. Readjust Main Trigger Level if necessary.

h. Observe risetime of less than 7 ns (dotted horizontal graticule lines are 10% and 90% references).

i. Set DISPLAY to B.

j. Repeat steps d through h for Channel B.

k. If results are incorrect perform adjustment procedure.

MODEL 1801A PERFORMANCE CHECK RECORD

Instrument Serial Number _____

Paragraph	Check	Min	Reading	Max
5-12	Deflection Factor			
step d	.005	5.82 div	_____	6.18 div
	.01	4.85 div	_____	5.15 div
	.02	4.85 div	_____	5.15 div
	.05	5.82 div	_____	6.18 div
	.1	4.85 div	_____	5.15 div
	.2	4.85 div	_____	5.15 div
	.5	5.82 div	_____	6.18 div
	1	4.85 div	_____	5.15 div
	2	4.85 div	_____	5.15 div
	5	5.82 div	_____	6.18 div
	10	4.85 div	_____	5.15 div
	20	4.85 div	_____	5.15 div
5-13	Vernier			
step b	B		_____	2 div
step f	A		_____	2 div
5-14	C. M. R.			
step h	A+B		_____	0.3 div
5-15	Bandwidth			
step g	A 50 MHz	5.7 div		
step j	B 50 MHz	5.7 div		
5-16	Triggering			
step c	B	Stable display	_____	Yes or No
step d	A	Stable display	_____	Yes or No
Step i	CHOP A or B	Stable display	_____	Yes or No
5-17	Risetime			
step f	A		_____	7 nsec
step h	B		_____	7 nsec

5-18. ADJUSTMENTS.

5-19. Procedures for making adjustment in Model 1801A are given in the following paragraphs. Required test equipment is listed in Table 5-1. Test equipment with similar characteristics may be substituted if necessary. Figure 5-3 shows the location of adjustments in the Model 1801A.

5-20. PRELIMINARY SETUP.

5-21. Lock the plug-ins together and install in HP 180-series oscilloscope. Apply power and allow 15-minute warm-up. Remove mainframe cover from lower left-hand side and set the mainframe on its top.

5-22. INITIAL CONTROL SETTINGS.

a. Set HP 180-series oscilloscope controls:

Horizontal Magnifier	X1
Horizontal Display	Internal

b. Set Model 1801A controls:

DISPLAY	A
A and B POLARITY	+UP
A and B Vernier	CAL
A and B VOLTS/DIV	0.005
A and B coupling	GND

c. Set time base controls (as applicable).

Sweep Display	Main Sweep
Sweep Mode	Auto Sweep
Main Vernier	Calibrated Operation
Main Trigger Source	Internal
Main Slope	+ (Positive)
Main Trigger Coupling	ac
Main Sweep Time	1 msec/div
Delayed Sweep Time	off

5-23. AMPLIFIER BALANCE AND DC LEVEL.

a. Obtain baseline with Channel A POSITION (Channel B POSITION) and intensity controls.

b. Adjust DC BAL A (DC BAL B) for less than 0.2 div vertical shift of baseline while switching Channel A POLARITY (Channel B POLARITY) between +UP and −UP.

c. Adjust A3R25 (A3R65) for less than 0.2 div vertical shift of baseline while rotating Channel A Vernier (Channel B Vernier) from one extreme to other.

d. Repeat steps b and c until no further adjustment is required.

e. Set DISPLAY to B and repeat steps a through d for Channel B.

5-24. A + B BAL.

a. Set DISPLAY to B (A).

b. Center baseline exactly with Channel B POSITION (Channel A POSITION).

c. Repeat steps a and b for Channel A.

d. Set DISPLAY to A + B.

e. Adjust A3R54 to re-center trace.

5-25. TRIGGER AMPLIFIER BALANCE.

a. Set Model 1801A controls:

DISPLAY	A
A and B VOLTS/DIV	.5
A and B POLARITY	+UP

b. Set time base Sweep mode for normal operation.

c. Connect 1V pk-to-pk, 400-Hz signal from Voltmeter Calibrator to Channel A INPUT (Channel B INPUT).

d. Set time base Trigger Coupling to AC.

e. Adjust time base Trigger Level so sweep starts at center graticule line and display centered.

f. Set time base Trigger Coupling to DC.

g. Adjust trigger balance control A5R33 so sweep starts at same point as in step e.

h. Connect 1V pk-to-pk, 400-Hz signal from voltmeter calibrator to channel A INPUT.

i. Switch DISPLAY to A + B.

j. Repeat steps d through g for A + B except adjust trigger balance control A5R22 so sweep starts at same point as in step e.

5-26. GAIN.

a. Set Model 1801A controls:

DISPLAY	A
Channel A coupling	AC
A + B VOLTS/DIV	.005

b. Set time base Sweep Mode to AUTO operation.

c. Connect 400-Hz, 30-mV pk-pk signal from Voltmeter Calibrator output to Channel A INPUT.

d. Adjust Channel A CAL for 6 div display.

e. Connect 400 Hz, 30 mV pk-pk signal from Voltmeter Calibrator output to Channel A INPUT and Channel B INPUT.

f. Set Model 1801A controls:

DISPLAY . . . . . A + B
A POLARITY . . . . . +UP
B POLARITY . . . . . —UP
B coupling . . . . . AC

g. Adjust Channel B CAL for minimum vertical deflection.

5-27. ATTENUATOR COMPENSATION.

a. Set Model 1801A controls:

DISPLAY . . . . . A
Channel B POLARITY . . . . . +UP

NOTE

Plug-in Extender, HP Model 10407A/B, is necessary to make attenuator adjustments.

b. Set Main Sweep time to 20 usec/div.

c. Connect 10 kHz square wave from Square Wave Generator output to Channel A INPUT (Channel B INPUT).

d. Set Channel A VOLTS/DIV (Channel B VOLTS/DIV) according to Table 5-3 and adjust Square Wave Generator output for 5 div display.

e. Adjust time base Main Trigger Level for stable display.

f. Make appropriate adjustment according to Table 5-3 for best square wave response.

Table 5-3. Attenuator Compensation

VOLTS/DIV 01,,	ADJUST	
	Channel A	Channel B
.01	A1C17	A2C17
.02	A1C21	A2C21
.05	A1C6	A2C6
.1	A1C15	A2C15
.2	A1C19	A2C19
.5	C1C9	A2C9
5	A1C13	A1C13

g. Set DISPLAY to B and repeat steps c through f for Channel B.

5-28. INPUT CAPACITANCE.

a. Set Channel B VOLTS/DIV (Channel A VOLTS/DIV) to .005 and Channel B coupling (Channel A coupling) to DC.

b. Connect LC Meter to Channel B INPUT (Channel A INPUT).

c. Set Channel B VOLTS/DIV (Channel A VOLTS/DIV) according to Table 5-4 and make appropriate adjustment to obtain 25 pF input capacitance.

d. Set DISPLAY to A and repeat steps a through c.

Table 5-4. Input Capacitance

VOLTS/DIV	Adjust	
	Channel A	Channel B
.005	A1C2	A2C2
.05	A1C3	A2C3
.5	A1C7	A2C7
5	A1C11	A2C11

5-29. PULSE RESPONSE.

a. Set Channel A and Channel B VOLTS/DIV to .005 and coupling to DC.

b. Connect Pulse Generator output to Channel A INPUT using 50-ohm termination at INPUT.

c. Adjust Pulse Generator output amplitude for 8 div. vertical display centered on CRT.

d. Set adjustments as shown in Table 5-5.

NOTE

Change sweep time as necessary to display best pulse. Repeat the procedure if necessary until optimum pulse response is obtained.

e. If Channel B cannot be set properly with A3C20 and A3R89 in Table 5-5, readjust main amplifier adjustments until both channels meet required specifications.

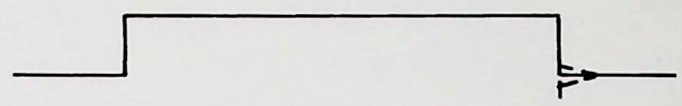
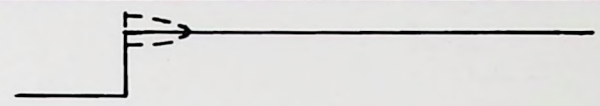
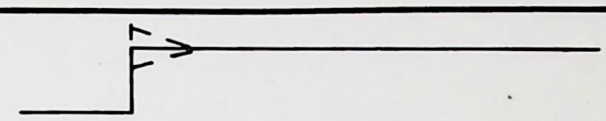
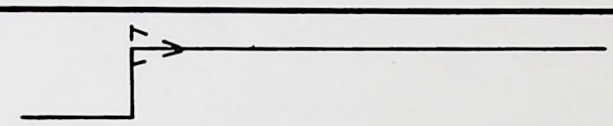
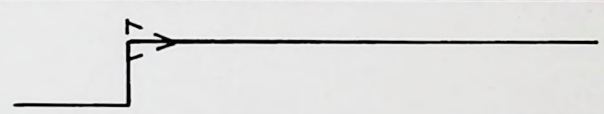
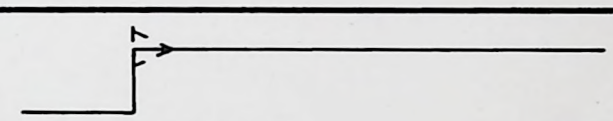
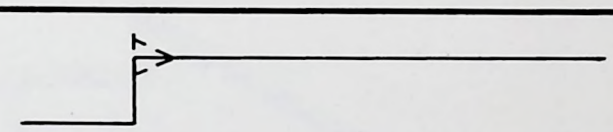
f. Adjust risetime for less than 7 ns.

g. Adjust pulse overshoot, undershoot, flat top and perturbations for optimum (typically less than 3%).

h. Switch A and B INPUTS to — (minus). Observe pulse of less than 7 ns.

i. Observe pulse risetime, overshoot, undershoot, flat top and perturbations. Readjust as necessary to achieve same results as in step g.

Table 5-5. Amplifier Pulse Response Adjustment

Location	Adjust	Effect on Pulse
Main Amp	A3C24	
Main Amp	A3C25	
Main Amp	A3C26	
Main Amp	A3C22	
Main Amp	A3C28 A3R106	
Channel A	A3C10 A3R49	
Channel B	A3C20 A3R89	

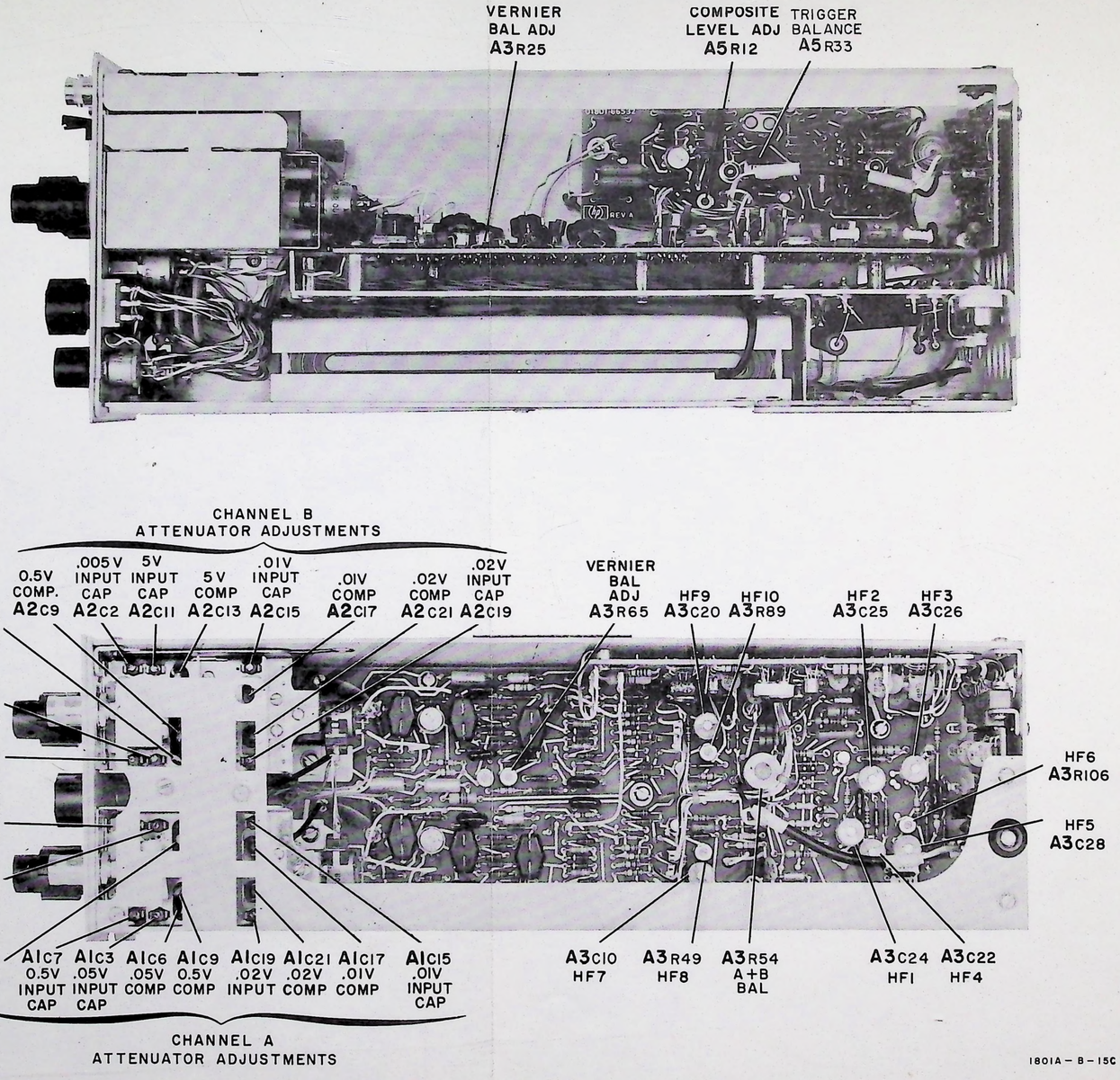


Figure 5-3. Adjustment Location

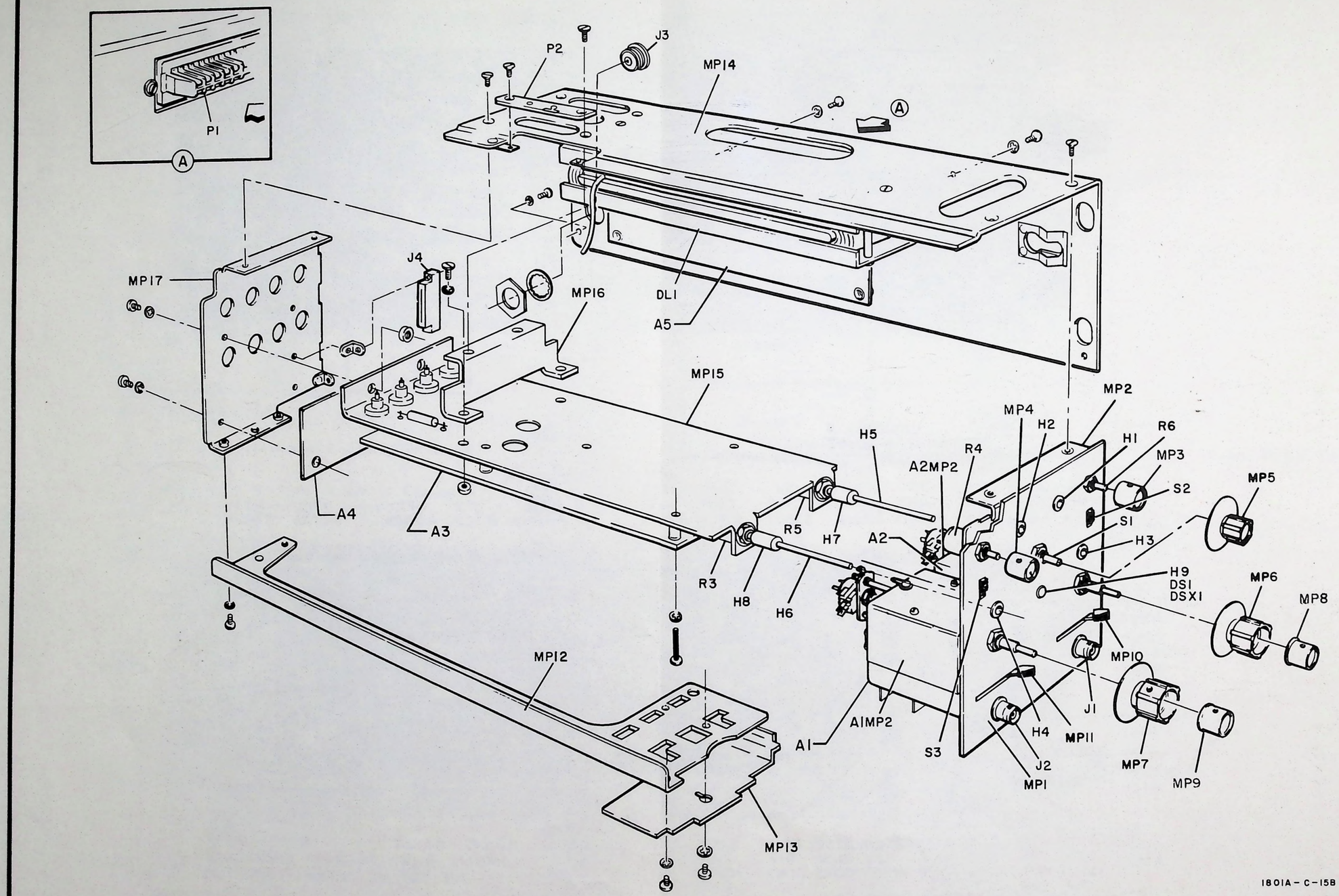


Figure 6-1. Mechanical Parts Location

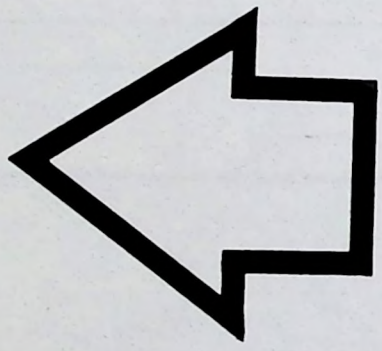


Figure 6-1, Mechanical Parts Location, inside fold.

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. The abbreviations used in the parts list are described in Table 6-1. Table 6-2 lists the parts in alphanumeric order. Table 6-3 lists the parts in order of the HP stock number and includes the manufacturer and manufacturers' part number. Table 6-4 contains the list of manufacturers' codes. Top assembly parts are illustrated in Figure 6-1.

6-3. ORDERING INFORMATION.

6-4. To obtain replacement parts from Hewlett-Packard, address order or inquiry to the nearest Hewlett-Packard Sales/Service Office and supply the following information:

a. Instrument model and serial number.

b. HP Part Number of item(s).

c. Quantity of part(s) desired.

d. Reference designator of part(s).

6-5. To order a part not listed in the table, provide the following information:

a. Instrument model and serial number.

b. Description of the part, including function and location in the instrument.

c. Quantity desired.

Table 6-1. Abbreviations for Replaceable Parts List

A	= ampere(s)
ASSY	= assembly
BD	= board(s)
BH	= binder head
BP	= bandpass
C	= centi (10^{-2})
CAR	= carbon
CCW	= counterclockwise
CER	= ceramic
CMO	= cabinet mount only
COAX	= coaxial
COEF	= coefficient
COMP	= composition
CONN	= connector(s)
CRT	= cathode-ray tube
CW	= clockwise
D	= deci (10^{-1})
DEPC	= deposited carbon
DP	= double pole
DT	= double throw
ELECT	= electrolytic
ENCAP	= encapsulated
EXT	= external
F	= farad(s)
FET	= field-effect transistor(s)
FH	= flat head
FIL H	= fillister head
FXD	= fixed
G	= giga (10^{9})
GE	= germanium
GL	= glass
GRD	= ground(ed)
H	= henry(ies)
HG	= mercury
HP	= Hewlett-Packard
HZ	= hertz
IF	= intermediate freq.
IMPG	= impregnated
INCD	= incandescent
INCL	= include(s)
INS	= insulation(ed)
INT	= internal
K	= kilo (10^{3})
KG	= kilogram
LB	= pound(s)
LH	= left hand
LIN	= linear taper
LOG	= logarithmic taper
LPF	= low-pass filter(s)
LVR	= lever
M	= milli (10^{-3})
MEG	= mega (10^{6})
MET FILM	= metal film
MET OX	= metal oxide
MFR	= manufacturer
MINAT	= miniature
MOM	= momentary
MTG	= mounting
MY	= mylar
N	= nano (10^{-9})
N/C	= normally closed
NE	= neon
N/O	= normally open
NPO	= negative positive zero (zero temperature coefficient)
NPN	= negative-positive-negative
NSR	= not separately replaceable
OBD	= order by description
OH	= oval head
OX	= oxide
P	= peak
PC	= printed (etched) circuit(s)
PF	= picofarads
PHL	= Phillips
PIV	= peak inverse voltage(s)
PNP	= positive-negative-positive
P/O	= part of
PORC	= porcelain
POS	= position(s)
POT	= potentiometer(s)
P-P	= peak-to-peak
PRGM	= program
PS	= polystyrene
PWV	= peak working voltage
RECT	= rectifier(s)
RF	= radio frequency
RFI	= radio frequency interference
RH	= round head or right hand
RMO	= rack mount only
RMS	= root mean square
RWV	= reverse working voltage
S-B	= slow-blow
SCR	= silicon controlled rectifier
SE	= selenium
SEC	= second(s)
SECT	= section(s)
SI	= silicon
SIL	= silver
SI	= slide
SP	= single pole
SPL	= special
ST	= single throw
STD	= standard
TA	= tantalum
TD	= time delay
TFL	= teflon
TGL	= toggle
THYR	= thyristor
TI	= titanium
TNLDIO	= tunnel diode(s)
TOL	= tolerance
TRIM	= trimmer
U	= micro (10^{-6})
V	= volts
VAR	= variable
VDCW	= dc working volt(s)
W	= watt(s)
W/	= with
WIV	= working inverse voltage
W/O	= without
WW	= wirewound

Table 6-2. Replaceable Parts

Reference Designation	Part No.	Description #	Note
A1	01801-63407	ASSY:ATTENUATOR "A"	
A1C1	0170-0043	C:FXD MY 0.022UF 10% 600 VDCW	
A1C2	0121-0407	C:VAR TRIMMER 0.7-3.0 PF	
A1C3	0121-0407	C:VAR TRIMMER 0.7-3.0 PF	
A1C4	0160-2474	C:FXD CER 14.2 PF 1% 500VDCW	
A1C5	0160-2234	C:FXD CER 0.51 ±0.25 PF 500VDCW	
A1C6	0121-0168	C:VAR TEFLON 0.25-1.50 PF 600VDCW	
A1C7	0121-0407	C:VAR TRIMMER 0.7-3.0 PF	
A1C8	0160-2261	C:FXD CER 15 PF 5% 500VDCW	
A1C9	0121-0168	C:VAR TEFLON 0.25-1.50 PF 600VDCW	
A1C10	0160-3130	C:FXD MICA 100 PF 10% 250VDCW	
A1C11	0121-0407	C:VAR TRIMMER 0.7-3.0 PF	
A1C12	0160-2262	C:FXD CER 16 PF 5% 500VDCW	
A1C13	0121-0168	C:VAR TEFLON 0.25-1.50 PF 600VDCW	
A1C14	0160-3463	C:FXD MICA 1000 PF 10% 250VDCW	
A1C15	0121-0407	C:VAR TRIMMER 0.7-3.0 PF	
A1C16	0160-2241	C:FXD CER 2.2 ±0.25 PF 500VDCW	
A1C17	0121-0429	C:VAR POLY 0.7-3.0 PF	
A1C18	0160-2257	C:FXD CER 10 PF 5% 500VDCW	
A1C19	0121-0407	C:VAR TRIMMER 0.7-3.0 PF	
A1C20	0160-2252	C:FXD CER 6.2 ±0.25 PF 500VDCW	
A1C21	0121-0429	C:VAR POLY 0.7-3.0 PF	
A1C22	0160-2241	C:FXD CER 2.2 ±0.25 PF 500VDCW	
A1MP1	01801-61203	BRACKET:ATTENUATOR "A"	
A1MP2	01801-00607	SHIELD:ATTENUATOR "A"	
A1MP3	01801-00609	SHIELD:ATTENUATOR BRACKET	
A1MP4	01801-01214	BRACKET(A1R14)	
A1MP5	01801-23206	SHAFT:VERNIER	
A1MP6	5040-0218	COUPLER:SWITCH SHAFT	
A1MP7	1750A-64A	HOLDER:TRIMMER	
A1R1		NOT ASSIGNED	
A1R2	0698-6400	R:FXD FLM 900K OHM 1.0% 1/4W	
A1R3	0698-5470	R:FXD FLM 111K OHM 1% 1/8W	
A1R4	0698-6634	R:FXD FLM 990K OHM 1.0% 1/4W	
A1R5	0698-3109	R:FXD MET FLM 10.1K OHM 1% 1/8W	
A1R6	0698-3146	R:FXD FLM 999K OHM 0.25% 1/4W	
A1R7	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
A1R8	0757-0346	R:FXD MET FLM 10 OHM 1% 1/8W	
A1R9	0698-3263	R:FXD MET FLM 500K OHM 1% 1/8W	
A1R10	0757-0344	R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	
A1R11	0757-0486	R:FXD MET FLM 750K OHM 1% 1/8W	
A1R12	0698-5471	R:FXD FLM 333K OHM 1% 1/8W	
A1R13	0757-0344	R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	
A1R14	2100-2008	R:VAR COMP 10K OHM 10% 10CLOG 1/4W	
A1S1	3100-2529	SWITCH:1 SECTION 3 POSITION	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	℗ Part No.	Description #	Note
A1S2	3100-2528	SWITCH:ROTARY 12 POSITION	
A2	01801-63408	ASSY:ATTENUATOR "B"	
A2C1	0170-0043	C:FXD MY 0.022UF 10% 600VDCW	
A2C2	0121-0407	C:VAR TRIMMER 0.7-3.0 PF	
A2C3	0121-0407	C:VAR TRIMMER 0.7-3.0 PF	
A2C4	0160-2474	C:FXD CER 14.2 PF 1% 500VDCW	
A2C5	0160-2234	C:FXD CER 0.51 ±0.25 PF 500VDCW	
A2C6	0121-0168	C:VAR TEFLON 0.25-1.50 PF 600VDCW	
A2C7	0121-0407	C:VAR TRIMMER 0.7-3.0 PF	
A2C8	0160-2261	C:FXD CER 15 PF 5% 500VDCW	
A2C9	0121-0168	C:VAR TEFLON 0.25-1.50 PF 600VDCW	
A2C10	0160-3130	C:FXD MICA 100 PF 10% 25CVDCW	
A2C11	0121-0407	C:VAR TRIMMER 0.7-3.0 PF	
A2C12	0160-2262	C:FXD CER 16 PF 5% 500VDCW	
A2C13	0121-0168	C:VAR TEFLON 0.25-1.50 PF 600VDCW	
A2C14	0160-3463	C:FXD MICA 1000 PF 10% 250VDCW	
A2C15	0121-0407	C:VAR TRIMMER 0.7-3.0 PF	
A2C16	0160-2241	C:FXD CER 2.2 ±0.25 PF 500VDCW	
A2C17	0121-0429	C:VAR POLY 0.7-3.0 PF	
A2C18	0160-2257	C:FXD CER 10 PF 5% 500VDCW	
A2C19	0121-0407	C:VAR TRIMMER 0.7-3.0 PF	
A2C20	0160-2252	C:FXD CER 6.2 ±0.25 PF 500VDCW	
A2C21	0121-0429	C:VAR POLY 0.7-3.0 PF	
A2C22	0160-2241	C:FXD CER 2.2 ±0.25 PF 500VDCW	
A2C23	0160-0168	C:FXD MICA 0.1 UF 10% 20CVDCW	
A2MP1	01801-61204	BRACKET:ATTENUATOR "B"	
A2MP2	01801-00606	SHIELD:ATTENUATOR "B"	
A2MP3	01801-00609	SHIELD:ATTENUATOR BRACKET	
A2MP4	01801-01215	BRACKET(A2R14)	
A2MP5	01801-23206	SHAFT:VERNIER	
A2MP6	5040-0218	COUPLER:SWITCH SHAFT	
A2MP7	1750A-64A	HOLDER:TRIMMER	
A2R1		NOT ASSIGNED	
A2R2	0698-6400	R:FXD FLM 900K OHM 1.0% 1/4W	
A2R3	0698-5470	R:FXD FLM 111K OHM 1% 1/8W	
A2R4	0698-6634	R:FXD FLM 990K OHM 1.0% 1/4W	
A2R5	0698-3109	R:FXD MET FLM 10.1K OHM 1% 1/8W	
A2R6	0698-3146	R:FXD FLM 999K OHM 0.25% 1/4W	
A2R7	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
A2R8	0757-0346	R:FXD MET FLM 10 OHM 1% 1/8W	
A2R9	0698-3263	R:FXD MET FLM 500K OHM 1% 1/8W	
A2R10	0757-0344	R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	
A2R11	0757-0486	R:FXD MET FLM 750K OHM 1% 1/8W	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	Part No.	Description #	Note
A2R12	0698-5471	R:FXD FLM 333K OHM 1% 1/8W	
A2R13	0757-0344	R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	
A2R14	2100-2008	R:VAR COMP 10K OHM 10% 10CLOG 1/4W	
A2S1	3100-2529	SWITCH:1 SECTION 3 POSITION	
A2S2	3100-2528	SWITCH:ROTARY 12 POSITION	
A3	01801-66538	BOARD ASSY:MAIN	
A3C1	0150-0024	C:FXD CER 0.02 UF +80-20% 600VDCW	
A3C2	0150-0024	C:FXD CER 0.02 UF +80-20% 600VDCW	
A3C3	0140-0205	C:FXD MICA 62 PF 5% 300VDCW	
A3C4	0140-0205	C:FXD MICA 62 PF 5% 300VDCW	
A3C5	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A3C6	0140-0226	C:FXD MICA 320 PF 1% 300VDCW	
A3C7	0140-0226	C:FXD MICA 320 PF 1% 300VDCW	
A3C8	0160-0153	C:FXD MY 0.001 UF 10% 200VDCW	
A3C9	0160-0153	C:FXD MY 0.001 UF 10% 200VDCW	
A3C10	0121-0046	C:VARI CER 9-35 PF	
A3C11	0160-2263	C:FXD CER 18 PF 5% 500VDCW	
A3C12	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A3C13	0140-0205	C:FXD MICA 62 PF 5% 300VDCW	
A3C14	0140-0205	C:FXD MICA 62 PF 5% 300VDCW	
A3C15	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A3C16	0140-0226	C:FXD MICA 320 PF 1% 300VDCW	
A3C17	0140-0226	C:FXD MICA 320 PF 1% 300VDCW	
A3C18	0160-0153	C:FXD MY 0.001 UF 10% 200VDCW	
A3C19	0160-0153	C:FXD MY 0.001 UF 10% 200VDCW	
A3C20	0121-0046	C:VARI CER 9-35 PF	
A3C21	0160-2263	C:FXD CER 18 PF 5% 500VDCW	
A3C22	0121-0046	C:VARI CER 9-35 PF	
A3C23	0140-0205	C:FXD MICA 62 PF 5% 300VDCW	
A3C24	0121-0046	C:VARI CER 9-35 PF	
A3C25	0121-0046	C:VARI CER 9-35 PF	
A3C26	0121-0061	C:VAR CER 5.5-18 PF	
A3C27	0140-0203	C:FXD MICA 30 PF 5% 500VDCW	
A3C28	0121-0046	C:VARI CER 9-35 PF	
A3C29	0160-2257	C:FXD CER 10 PF 5% 500VDCW	
A3C30	0150-0050	C:FXD CER DISC 1000 PF +80-20% 1000VDCW	
A3C31	0160-0161	C:FXD MY 0.01 UF 10% 200VDCW	
A3C32	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A3C33	0180-0116	C:FXD ELECT 6.8 UF 10% 35VDCW	
A3C34	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A3C35	0180-0116	C:FXD ELECT 6.8 UF 10% 35VDCW	
A3C36	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A3C37	0180-0228	C:FXD ELECT 22 UF 10% 15VDCW	
A3C38	0180-0228	C:FXD ELECT 22 UF 10% 15VDCW	
A3C39	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A3C40	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	℗ Part No.	Description #	Note
A3C41	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A3C42	0160-2255	C:FXD CER 8.2±0.25 PF 500VDCW	
A3C43	0160-2244	C:FXD CER 3.0 ±0.25 PF 500VDCW	
A3CR1	5080-0467	DIODE:SI MATCHED PAIR INCLUDES A3CR2	
A3CR2	5080-0467	N.S.R. PART OF A3CR1	
A3CR3	5080-0467	DIODE:SI MATCHED PAIR INCLUDES A3CR4	
A3CR4	5080-0467	N.S.R. PART OF A3CR3	
A3CR5	5080-0442	DIODE:SI MATCHED SET OF 8	
A3CR6		N.S.R. PART OF A3CR5	
A3CR7		N.S.R. PART OF A3CR5	
A3CR8		N.S.R. PART OF A3CR5	
A3CR9		N.S.R. PART OF A3CR5	
A3CR10		N.S.R. PART OF A3CR5	
A3CR11		N.S.R. PART OF A3CR5	
A3CR12		N.S.R. PART OF A3CR5	
A3CR13	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR14	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR15	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR16	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR17	5080-0442	DIODE:SI MATCHED SET OF 8	
A3CR18		N.S.R. PART OF A3CR17	
A3CR19		N.S.R. PART OF A3CR17	
A3CR20		N.S.R. PART OF A3CR17	
A3CR21		N.S.R. PART OF A3CR17	
A3CR22		N.S.R. PART OF A3CR17	
A3CR23		N.S.R. PART OF A3CR17	
A3CR24		N.S.R. PART OF A3CR17	
A3CR25	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR26	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR27	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR28	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR29	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR30	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR31	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR32	1901-0040	DIODE:SILICON 30MA 30WV	
A3L1	9100-2254	COIL: CHOKE .39 UH 10%	
A3L2	9100-2254	COIL: CHOKE .39 UH 10%	
A3L3	9100-2254	COIL: CHOKE .39 UH 10%	
A3L4	9100-2254	COIL: CHOKE .39 UH 10%	
A3L5	9100-2252	COIL: CHOKE 0.27 UH 10%	
A3L6	9100-2252	COIL: CHOKE 0.27 UH 10%	
A3L7	9100-2252	COIL: CHOKE 0.27 UH 10%	
A3L8	9100-2252	COIL: CHOKE 0.27 UH 10%	
A3L9		NOT ASSIGNED	
A3L10	9140-0179	COIL: CHOKE 22.0 UH 10%	
A3L11	9140-0179	COIL: CHOKE 22.0 UH 10%	
A3L12	9140-0179	COIL: CHOKE 22.0 UH 10%	
A3L13	9140-0179	COIL: CHOKE 22.0 UH 10%	
A3Q1	5080-0498	Q:FET(MATCHED PAIR)	
A3Q2		N.S.R. PART OF A3Q1	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	Part No.	Description #	Note
A3Q3	5080-0498	Q:FET(MATCHED PAIR)	
A3Q4		N.S.R. PART OF A3Q3	
A3Q5	5080-0494	Q: SI PNP MATCHED PAIR	
A3Q6		N.S.R PART OF A3Q5	
A3Q7	1853-0203	Q: SI PNP	
A3Q8	1853-0203	Q: SI PNP	
A3Q9	1854-0092	Q:SI NPN	
A3Q10	1854-0092	Q:SI NPN	
A3Q11	5080-9620	Q:SI NPN MATCHED QUAD	
A3Q12	5080-9620	N.S.R. PART OF A3Q11	
A3Q13	5080-0494	Q: SI PNP MATCHED PAIR	
A3Q14		N.S.R. PART OF A3Q13	
A3Q15	1853-0203	Q: SI PNP	
A3Q16	1853-0203	Q: SI PNP	
A3Q17	1854-0092	Q:SI NPN	
A3Q18	1854-0092	Q:SI NPN	
A3Q19	5080-9620	N.S.R. PART OF A3Q11	
A3Q20	5080-9620	N.S.R. PART OF A3Q11	
A3Q21	1854-0215	Q:SI NPN	
A3Q22	1854-0215	Q:SI NPN	
A3Q23	5080-9621	Q: SI NPN MATCHED PAIR	
A3Q24	5080-9621	N.S.R. PART OF A3Q23	
A3R1	0757-0475	R:FXD MET FLM 274K OHM 1% 1/8W	
A3R2	0757-0900	R:FXD MET FLM 100 OHM 2% 1/8W	
A3R3	0757-0900	R:FXD MET FLM 100 OHM 2% 1/8W	
A3R4	0757-0433	R:FXD MET FLM 3.32K OHM 1% 1/8W	
A3R5	0757-0433	R:FXD MET FLM 3.32K OHM 1% 1/8W	
A3R6	0757-0281	R:FXD MET FLM 2.74K OHM 1% 1/8W	
A3R7	0757-0281	R:FXD MET FLM 2.74K OHM 1% 1/8W	
A3R8	0757-0475	R:FXD MET FLM 274K OHM 1% 1/8W	
A3R9	0757-0900	R:FXD MET FLM 100 OHM 2% 1/8W	
A3R10	0757-0900	R:FXD MET FLM 100 OHM 2% 1/8W	
A3R11	0757-0433	R:FXD MET FLM 3.32K OHM 1% 1/8W	
A3R12	0757-0433	R:FXD MET FLM 3.32K OHM 1% 1/8W	
A3R13	0757-0281	R:FXD MET FLM 2.74K OHM 1% 1/8W	
A3R14	0757-0281	R:FXD MET FLM 2.74K OHM 1% 1/8W	
A3R15		NOT ASSIGNED	
A3R16	0757-0421	R:FXD MET FLM 825 OHM 1% 1/8W	
A3R17	0757-0421	R:FXD MET FLM 825 OHM 2% 1/8W	
A3R18	0757-0897	R:FXD FLM 75 OHM 2% 1/8W	
A3R19	0757-0282	R:FXD MET FLM 221 OHM 1% 1/8W	
A3R20	0757-0282	R:FXD MET FLM 221 OHM 1% 1/8W	
A3R21	0757-0893	R:FXD FLM 51 OHM 2% 1/8W	
A3R22	0757-0893	R:FXD FLM 51 OHM 2% 1/8W	
A3R23	0757-0400	R:FXD MET FLM 90.9 OHM 1% 1/8W	
A3R24	0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	
A3R25	2100-2060	R:VAR FLM 50 OHM 20% LIN 1/2W	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	Part No.	Description #	Note
A3R26	0757-0388	R:FXD FLM 30.1 OHM 1% 1/8W	
A3R27	0757-0428	R:FXD MET FLM 1.62K 1% 1/8W	
A3R28	0757-0907	R:FXD FLM 200 OHM 2% 1/8W	
A3R29	0757-0900	R:FXD MET FLM 100 OHM 2% 1/8W	
A3R30	0757-0900	R:FXD MET FLM 100 OHM 2% 1/8W	
A3R31	0698-3443	R:FXD MET FLM 287 OHM 1% 1/8W	
A3R32	0698-3443	R:FXD MET FLM 287 OHM 1% 1/8W	
A3R33	0757-0382	R:FXD MET FLM 16.2 OHM 1% 1/8W	
A3R34	0757-0417	R:FXD MET FLM 562 OHM 1% 1/8W	
A3R35	0757-0417	R:FXD MET FLM 562 OHM 1% 1/8W	
A3R36	0757-0410	R:FXD MET FLM 301 OHM 1% 1/8W	
A3R37	0757-0410	R:FXD MET FLM 301 OHM 1% 1/8W	
A3R38	0757-0410	R:FXD MET FLM 301 OHM 1% 1/8W	
A3R39	0757-0410	R:FXD MET FLM 301 OHM 1% 1/8W	
A3R40	0757-0388	R:FXD FLM 30.1 OHM 1% 1/8W	
A3R41	0757-0388	R:FXD FLM 30.1 OHM 1% 1/8W	
A3R42	0757-0435	R:FXD FLM 3920 OHM 1% 1/8W	
A3R43	0757-0435	R:FXD FLM 3920 OHM 1% 1/8W	
A3R44	0698-3132	R:FXD FLM 261 OHM 1% 1/8W	
A3R45	0698-3132	R:FXD FLM 261 OHM 1% 1/8W	
A3R46	0757-0282	R:FXD MET FLM 221 OHM 1% 1/8W	
A3R47	0757-0282	R:FXD MET FLM 221 OHM 1% 1/8W	
A3R48	0757-0400	R:FXD MET FLM 90.9 OHM 1% 1/8W	
A3R49	2100-2061	R:VAR FLM 200 OHM 10% LIN 1/2W	
A3R50	0698-4037	R:FXD MET FLM 46.4 OHM 1% 1/8W	
A3R51	0698-4037	R:FXD MET FLM 46.4 OHM 1% 1/8W	
A3R52	0757-0732	R:FXD MET FLM 909 OHM 1% 1/4W	
A3R53	0757-0732	R:FXD MET FLM 909 OHM 1% 1/4W	
A3R54	2100-1773	R:VAR WW 1K OHM 5% TYPE H 1W	
A3R55		NOT ASSIGNED	
A3R56	0757-0421	R:FXD MET FLM 825 OHM 1% 1/8W	
A3R57	0757-0421	R:FXD MET FLM 825 OHM 1% 1/8W	
A3R58	0757-0897	R:FXD FLM 75 OHM 2% 1/8W	
A3R59	0757-0282	R:FXD MET FLM 221 OHM 1% 1/8W	
A3R60	0757-0282	R:FXD MET FLM 221 OHM 1% 1/8W	
A3R61	0757-0893	R:FXD FLM 51 OHM 2% 1/8W	
A3R62	0757-0893	R:FXD FLM 51 OHM 2% 1/8W	
A3R63	0757-0400	R:FXD MET FLM 90.9 OHM 1% 1/8W	
A3R64	0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	
A3R65	2100-2060	R:VAR FLM 50 OHM 20% LIN 1/2W	
A3R66	0757-0388	R:FXD FLM 30.1 OHM 1% 1/8W	
A3R67	0757-0428	R:FXD MET FLM 1.62K 1% 1/8W	
A3R68	0757-0907	R:FXD FLM 200 OHM 2% 1/8W	
A3R69	0757-0900	R:FXD MET FLM 100 OHM 2% 1/8W	
A3R70	0757-0900	R:FXD MET FLM 100 OHM 2% 1/8W	
A3R71	0698-3443	R:FXD MET FLM 287 OHM 1% 1/8W	
A3R72	0698-3443	R:FXD MET FLM 287 OHM 1% 1/8W	
A3R73	0757-0382	R:FXD MET FLM 16.2 OHM 1% 1/8W	
A3R74	0757-0417	R:FXD MET FLM 562 OHM 1% 1/8W	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	Part No.	Description #	Note
A3R75	0757-0417	R:FXD MET FLM 562 OHM 1% 1/8W	
A3R76	0757-0410	R:FXD MET FLM 301 OHM 1% 1/8W	
A3R77	0757-0410	R:FXD MET FLM 301 OHM 1% 1/8W	
A3R78	0757-0410	R:FXD MET FLM 301 OHM 1% 1/8W	
A3R79	0757-0410	R:FXD MET FLM 301 OHM 1% 1/8W	
A3R80	0757-0388	R:FXD FLM 30.1 OHM 1% 1/8W	
A3R81	0757-0388	R:FXD FLM 30.1 OHM 1% 1/8W	
A3R82	0757-0435	R:FXD FLM 3920 OHM 1% 1/8W	
A3R83	0757-0435	R:FXD FLM 3920 OHM 1% 1/8W	
A3R84	0698-3132	R:FXD FLM 261 OHM 1% 1/8W	
A3R85	0698-3132	R:FXD FLM 261 OHM 1% 1/8W	
A3R86	0757-0282	R:FXD MET FLM 221 OHM 1% 1/8W	
A3R87	0757-0282	R:FXD MET FLM 221 OHM 1% 1/8W	
A3R88	0757-0400	R:FXD MET FLM 90.9 OHM 1% 1/8W	
A3R89	2100-2061	R:VAR FLM 200 OHM 10% LIN 1/2W	
A3R90	0698-4037	R:FXD MET FLM 46.4 OHM 1% 1/8W	
A3R91	0698-4037	R:FXD MET FLM 46.4 OHM 1% 1/8W	
A3R92	0757-0283	R:FXD MET FLM 2.00K OHM 1% 1/8W	
A3R93	0757-0400	R:FXD MET FLM 90.9 OHM 1% 1/8W	
A3R94	0698-3446	R:FXD MET FLM 383 OHM 1% 1/8W	
A3R95	0698-3446	R:FXD MET FLM 383 OHM 1% 1/8W	
A3R96	0757-0723	R:FXD FLM 365 OHM 1% 1/4W	
A3R97	0757-0723	R:FXD FLM 365 OHM 1% 1/4W	
A3R98	0757-0735	R:FXD FLM 1.3K OHM 1% 1/4W	
A3R99	0757-0735	R:FXD FLM 1.3K OHM 1% 1/4W	
A3R100	0757-0393	R:FXD FLM 47.5 OHM 1% 1/8W	
A3R101	0757-0428	R:FXD MET FLM 1.62K 1% 1/8W	
A3R102	0757-0403	R:FXD MET FLM 121 OHM 1% 1/8W	
A3R103	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
A3R104	0698-0082	R:FXD MET FLM 464 OHM 1% 1/8W	
A3R105	0757-0449	R:FXD FLM 20K OHM 1% 1/8W	
A3R106	2100-2061	R:VAR FLM 200 OHM 10% LIN 1/2W	
A3R107	0698-3445	R:FXD MET FLM 348 OHM 1% 1/8W	
A3R108	0757-0900	R:FXD MET FLM 100 OHM 2% 1/8W	
A3R109	0757-0900	R:FXD MET FLM 100 OHM 2% 1/8W	
A3R110	0757-0422	R:FXD MET FLM 909 OHM 1% 1/8W	
A3R111	0757-0839	R:FXD MET FLM 10.0K OHM 1% 1/2W	
A3R112	0757-0719	R:FXD MET FLM 221 OHM 1% 1/4W	
A3R113	0698-3444	R:FXD MET FLM 316 OHM 1% 1/8W	
A3R114	0757-0417	R:FXD MET FLM 562 OHM 1% 1/8W	
A3R115	0698-3444	R:FXD MET FLM 316 OHM 1% 1/8W	
A3R116	0757-0417	R:FXD MET FLM 562 OHM 1% 1/8W	
A3R117	0757-0346	R:FXD MET FLM 10 OHM 1% 1/8W	
A3R118	0757-0346	R:FXD MET FLM 10 OHM 1% 1/8W	
A3R119	0757-0436	R:FXD MET FLM 4.32K OHM 1% 1/8W	
A3R120	0757-0436	R:FXD MET FLM 4.32K OHM 1% 1/8W	
A3R121	0757-0436	R:FXD MET FLM 4.32K OHM 1% 1/8W	
A3R122	0757-0436	R:FXD MET FLM 4.32K OHM 1% 1/8W	
A3U1	1820-0352	INTEGRATED CIRCUIT:DIGITAL	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	℗ Part No.	Description #	Note
A3U2	1820-0352	INTEGRATED CIRCUIT:DIGITAL	
A3VR1	1902-0041	DIODE:BREAKDOWN 5.11V 5%	
A3VR2	1902-0041	DIODE:BREAKDOWN 5.11V 5%	
A3VR3	1902-0186	DIODE BREAKDOWN:32.4V 5% 400MW	
A4	01801-66530	BOARD ASSY:MULTIVIBRATOR	
A4C1	0160-2204	C:FXD MICA 100PF 5% 300VDCW	
A4C2	0160-2204	C:FXD MICA 100PF 5% 300VDCW	
A4C3	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A4C4	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A4C5	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A4C6	0160-2927	C:FXD CER 0.1 UF +80-20% 50 VDCW	
A4C7	0140-0228	C:FXD MICA 360 PF 1% 300VDCW	
A4C8	0140-0228	C:FXD MICA 360 PF 1% 300VDCW	
A4C9	0140-0198	C:FXD MICA 200 PF 5% 300VDCW	
A4C10	0140-0198	C:FXD MICA 200 PF 5% 300VDCW	
A4C11	0180-0155	C:FXD ELECT 2.2 UF 20% 20VDCW	
A4C12	0180-0155	C:FXD ELECT 2.2 UF 20% 20VDCW	
A4CR1	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR2	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR3	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR4	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR5	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR6	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR7	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR8	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR9	1901-0040	DIODE:SILICON 30MA 30WV	
A4CR10	1901-0040	DIODE:SILICON 30MA 30WV	
A4L1	9100-1623	COIL:CHOKE 27 UH 5%	
A4L2	9100-1623	COIL:CHOKE 27 UH 5%	
A4L3	9100-1623	COIL:CHOKE 27 UH 5%	
A4Q1	1853-0015	Q:SI PNP	
A4Q2	1853-0015	Q:SI PNP	
A4Q3	1854-0019	Q:SI NPN(SELECTED FROM 2N2369)	
A4Q4	1854-0019	Q:SI NPN(SELECTED FROM 2N2369)	
A4Q5	1854-0019	Q:SI NPN(SELECTED FROM 2N2369)	
A4R1	0757-0420	R:FXD MET FLM 750 OHM 1% 1/8W	
A4R2	0757-0420	R:FXD MET FLM 750 OHM 1% 1/8W	
A4R3	0698-3444	R:FXD MET FLM 316 OHM 1% 1/8W	
A4R4	0757-0397	R:FXD MET FLM 68.1 OHM 1% 1/8W	
A4R5	0757-0397	R:FXD MET FLM 68.1 OHM 1% 1/8W	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	℗ Part No.	Description #	Note
A4R6	0757-0947	R:FXD FLM 9.1K OHM 2% 1/8W	
A4R7	0757-0947	R:FXD FLM 9.1K OHM 2% 1/8W	
A4R8	0757-0444	R:FXD MET FLM 12.1K OHM 1% 1/8W	
A4R9	0757-0461	R:FXD MET FLM 68.1K OHM 1% 1/8W	
A4R10	0757-0429	R:FXD MET FLM 1.82K OHM 1% 1/8W	
A4R11	0757-0461	R:FXD MET FLM 68.1K OHM 1% 1/8W	
A4R12	0757-1069	R:FXD MET FLM 388 OHM 1.0% 1/2W	
A4R13	0757-0427	R:FXD MET FLM 1.5K 1% 1/8W	
A4R14	0757-0427	R:FXD MET FLM 1.5K 1% 1/8W	
A4R15	0761-0026	R:FXD MET OX 220 OHM 5% 1W	
A4R16	0757-0897	R:FXD FLM 75 OHM 2% 1/8W	
A4R17	0757-0283	R:FXD MET FLM 2.00K OHM 1% 1/8W	
A4R18	0757-0283	R:FXD MET FLM 2.00K OHM 1% 1/8W	
A4R19	0757-0897	R:FXD FLM 75 OHM 2% 1/8W	
A4R20	0757-0283	R:FXD MET FLM 2.00K OHM 1% 1/8W	
A4R21	0757-0924	R:FXD MET FLM 1K OHM 2% 1/8W	
A4R22	0757-0897	R:FXD FLM 75 OHM 2% 1/8W	
A4R23	0757-0416	R:FXD MET FLM 511 OHM 1% 1/8W	
A4VR1	1902-0074	DIODE:BREAKDOWN 7.15V 5%	
A4VR2	1902-3048	DIODE BREAKDOWN:SILICON 3.48V 5%	
A5	01801-66536	BOARD ASSY:SYNC AMPLIFIER	
A5C1		NOT ASSIGNED	
A5C2		NOT ASSIGNED	
A5C3		NOT ASSIGNED	
A5C4	0160-3451	C:FXD CER 0.01 UF +80–20% 100VDCW	
A5C5	0160-3451	C:FXD CER 0.01 UF +80–20% 100VDCW	
A5C6	0160-3451	C:FXD CER 0.01 UF +80–20% 100VDCW	
A5C7	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A5C8	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A5C9	0160-3451	C:FXD CER 0.01 UF +80–20% 100VDCW	
A5C10	0140-0203	C:FXD MICA 30 PF 5%	
A5C11	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A5C12	0160-3451	C:FXD CER 0.01 UF +80–20% 100VDCW	
A5C13	0160-3451	C:FXD CER 0.01 UF +80–20% 100VDCW	
A5C14	0160-3451	C:FXD CER 0.01 UF +80–20% 100VDCW	
A5C15	0160-3451	C:FXD CER 0.01 UF +80–20% 100VDCW	
A5C16	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A5C17	0160-3451	C:FXD CER 0.01 UF +80–20% 100VDCW	
A5CR1	1901-0040	DIODE:SILICON 30MA 30WV	
A5L1	9100-2274	COIL:CHOKE 68.0 UH 10%	
A5L2	9100-2274	COIL:CHOKE 68.0 UH 10%	
A5Q1	5080-9021	TSTR:SI NPN MATCHED PAIR (INCLUDES A5Q2	
A5Q2		NSR:P/O A5Q1	
A5Q3	1854-0019	TSTR:SI NPN	
A5Q4	1854-0019	TSTR:SI NPN	
A5Q5	1854-0019	TSTR:SI NPN	
A5Q6	1854-0019	TSTR:SI NPN	
A5Q7	1854-0019	TSTR:SI NPN	
A5Q8	1853-0203	TSTR:SI PNP	
A5R1		NOT ASSIGNED	
A5R2		NOT ASSIGNED	
A5R3		NOT ASSIGNED	
A5R4		NOT ASSIGNED	
A5R5		NOT ASSIGNED	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	℗ Part No.	Description #	Note
A5R6	0757-0407	R:FXD MET FLM 200 OHM 1% 1/8W	
A5R7	0757-0407	R:FXD MET FLM 200 OHM 1% 1/8W	
A5R8	0757-0276	R:FXD MET FLM 61.9 OHM 1% 1/8W	
A5R9	0757-0276	R:FXD MET FLM 61.9 OHM 1% 1/8W	
A5R10	0757-0845	R:FXD MET FLM 18.2K OHM 1.0% 1/2W	
A5R11	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A5R12	0757-0407	R:FXD MET FLM 200 OHM 1% 1/8W	
A5R13	0757-0407	R:FXD MET FLM 200 OHM 1% 1/8W	
A5R14	0757-0276	R:FXD MET FLM 61.9 OHM 1% 1/8W	
A5R15	0757-0276	R:FXD MET FLM 61.9 OHM 1% 1/8W	
A5R16	0757-0845	R:FXD MET FLM 18.2K OHM 1.0% 1/2W	
A5R17	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A5R18	0757-0416	R:FXD MET FLM 511 OHM 1% 1/8W	
A5R19	0757-0416	R:FXD MET FLM 511 OHM 1% 1/8W	
A5R20	0698-3435	R:FXD MET FLM 38.3 OHM 1% 1/8W	
A5R21	0698-3435	R:FXD MET FLM 38.3 OHM 1% 1/8W	
A5R22	2100-1986	R:VAR CERMET 1K 10% LIN 1/2W	
A5R23	0757-0426	R:FXD FLM 1.3K OHM 1% 1/8W	
A5R24	0757-0406	R:FXD MET FLM 182 OHM 1% 1/8W	
A5R25	0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	
A5R26	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A5R27	0698-3439	R:FXD MET FLM 178 OHM 1% 1/8W	
A5R28	0757-0430	R:FXD MET FLM 2.21K OHM 1% 1/8W	
A5R29	0757-0346	R:FXD MET FLM 10 OHM 1% 1/8W	
A5R30	0757-0346	R:FXD MET FLM 10 OHM 1% 1/8W	
A5R31	0757-0426	R:FXD FLM 1.3K OHM 1% 1/8W	
A5R32	0757-0430	R:FXD MET FLM 2.21K OHM 1% 1/8W	
A5R33	2100-1986	R:VAR CERMET 1K OHM 10% LIN 1/2W	
A5R34	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
A5R35	0698-3430	R:FXD MET FLM 21.5 OHM 1% 1/8W	
A5R36	0698-3441	R:FXD MET FLM 215 OHM 1% 1/8W	
A5R37	0757-0415	R:FXD MET FLM 475 OHM 1% 1/8W	
A5R38	0757-0429	R:FXD MET FLM 1.82K OHM 1% 1/8W	
A5R39	0698-3439	R:FXD MET FLM 178 OHM 1% 1/8W	
A5R40	0757-0281	R:FXD MET FLM 2.74K OHM 1% 1/8W	
A5R41	0757-0407	R:FXD MET FLM 200 OHM 1% 1/8W	
A5R42	0757-0407	R:FXD MET FLM 200 OHM 1% 1/8W	
A5R43	0757-0441	R:FXD MET FLM 8.25K OHM 1% 1/8W	
A5R44	0757-0273	R:FXD MET FLM 3.01K OHM 1% 1/8W	
A5R45	0757-0410	R:FXD MET FLM 301 OHM 1% 1/8W	
A5R46	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
A5R47	0757-0418	R:FXD MET FLM 619 OHM 1% 1/8W	
A5R48	0698-3444	R:FXD MET FLM 316 OHM 1% 1/8W	
A5R49	0757-0416	R:FXD MET FLM 511 OHM 1% 1/8W	
A5J1	1821-0002	TRANSISTOR ARRAY:SI NPN	
A5TP1	0360-0124	TERMINAL:SOLDER LUG	
A5U1	1820-0352	INTEGRATED CIRCUIT:DIGITAL	
A5VR1		NOT ASSIGNED	
A5VR2		NOT ASSIGNED	
A5VR3	1902-0041	DIODE:BREAKDOWN 5.11V 5%	
A5VR4	1902-3059	DIODE:BREAKDOWN 3.83V 5%	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	Part No.	Description #	Note
		CHASSIS PARTS	
C1	0180-0230	C:FXD ELECT 1.0 UF 20% 50VDCW	
C2	0180-0230	C:FXD ELECT 1.0 UF 20% 50VDCW	
C3	0160-0153	C:FXD MY 0.001 UF 10% 200VDCW	
C4	0160-0153	C:FXD MY 0.001 UF 10% 200VDCW	
C5	0160-0380	C:FXD MY 0.22 UF 10% 200VDCW	
C6	0150-0050	C:FXD CER DISC 1000 PF +80-20% 1000VDCW	
C7	0150-0050	C:FXD CER DISC 1000 PF +80-20% 1000VDCW	
DL1	01801-66531	DELAY LINE:DUAL 162 NS	
DS1	2140-0018	LAMP:GLOW 1/10W	
DSX1	5060-0458	HEADER:LAMP	
E1	0340-0152	INSULATOR:TRANSISTOR	
E2	0340-0152	INSULATOR:TRANSISTOR	
E3	0340-0152	INSULATOR:TRANSISTOR	
E4	0340-0152	INSULATOR:TRANSISTOR	
E5	5020-0513	CONTACT:ELECTRICAL	
E6	5020-0513	CONTACT:ELECTRICAL	
E7	5020-0513	CONTACT:ELECTRICAL	
E8	5020-0513	CONTACT:ELECTRICAL	
H1	1490-0968	BUSHING:POT(DC-BAL)	
H2	1490-0968	BUSHING:POT(DC-BAL)	
H3			
H4			
H5			
H6			
H7			
H8			
H9	5060-0451	LENS ASSY	
H10	5000-0543	SPRING:LEAF	
H11	5000-0543	SPRING:LEAF	
H12	5000-0543	SPRING:LEAF	
H13	5000-0543	SPRING:LEAF	
H14	0340-0039	INSULATOR:BUSHING	
H15	0340-0039	INSULATOR:BUSHING	
H16	0340-0039	INSULATOR:BUSHING	
H17	0340-0039	INSULATOR:BUSHING	
H18	1490-0968	BUSHING:POT (INTENS. BAL)	
H19	1490-0968	BUSHING:POT (INTENS. BAL)	
J1	1250-0001	CONNECTOR:BNC BULKHEAD	
J2	1250-0001	CONNECTOR:BNC BULKHEAD	
J3	1250-0897	CONNECTOR:RF BULKHEAD JACK RECEPTACLE	
J4	1251-0198	CONNECTOR:P C 12 CONTACT	
L1	9170-0029	CORE:FERRITE BEAD	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	℗ Part No.	Description #	Note
L2	9170-0029	CORE:FERRITE BEAD	
L3	9140-0179	COIL:CHOKE 22.0 UH 10%	
L4	9140-0179	COIL:CHOKE 22.0 UH 10%	
L5	9140-0142	COIL:FXD RF 2.2 UH	
L6	9140-0142	COIL:FXD RF 2.2 UH	
MP1	01801-00223	PANEL:FRONT	
MP2	01801-00221	PANEL:SUB	
MP3	00180-67402	KNOB	
MP4	00180-67402	KNOB	
MP5	01801-67404	KNOB:VERTICAL DISPLAY	
MP6	01801-67403	KNOB:BLACK(VOLTS/DIV)	
MP7	01801-67403	KNOB:BLACK(VOLTS/DIV	
MP8	01801-67401	KNOB:BLACK(CAL)	
MP9	01801-67401	KNOB:BLACK(CAL)	
MP10	0370-0432	KNOB:BLACK LEVER	
MP11	0370-0432	KNOB:BLACK LEVER	
MP12	01801-04703	SUPPORT:PLUG-IN	
MP13	01801-04104	COVER:SUPPORT	
MP14	01801-60101	CHASSIS ASSY:LEFT	
MP15	01801-01219	BRACKET:MAIN	
MP16	01801-00608	SHIELD:OUTPUT	
MP17	01801-00222	PANEL:REAR	
P1	01801-27601	P:MALE 24 PIN	
P2	01801-26506	P:SLIDE 2 PIN	
Q1	5080-9680	Q:SI NPN (MATCHED PAIR)	
Q2	1854-0091	Q:(P/O Q1)	
Q3	5080-9679	Q:SI NPN (MATCHED PAIR)	
Q4	1854-0056	Q:(NSR P/O Q3)	
R1	2100-2062	R:VAR COMP 500 OHM 10% LIN 1/2W	
R2	2100-2062	R:VAR COMP 500 OHM 10% LIN 1/2W	
R3	2100-2887	R:VAR COMP 20K OHM 10% 1/4W	
R4	2100-2488	R:VAR COMP 10K OHM 10% LIN 3/4W	
R5	2100-2887	R:VAR COMP 20K OHM 10% 1/4W	
R6	2100-2488	R:VAR COMP 10K OHM 10% LIN 3/4W	
R7	0757-0828	R:FXD MET FLM 3.01K OHM 1% 1/2W	
R8	0811-1153	R:FXD WW 360 OHM 1.0% 4W	
R9	0811-1153	R:FXD WW 360 OHM 1.0% 4W	
R10	0811-2069	R:FXD WW 162 OHM 1% 3W	
R11	0811-2069	R:FXD WW 162 OHM 1% 3W	
R12	0811-2548	R:FXD WW 750 OHM 1%	
R13	0811-2548	R:FXD WW 750 OHM 1%	
R14	0757-0399	R:FXD MET FLM 82.5 OHM 1% 1/8W	
R15	0757-0399	R:FXD MET FLM 82.5 OHM 1% 1/8W	
R16	0757-0454	R:FXD MET FLM 33.2K CHM 1% 1/8W	
S1	3100-2527	SWITCH:ROTARY 3 SECT 8 POSITION	
S2	3101-0070	SWITCH:SLIDE	
S3	3101-0070	SWITCH:SLIDE	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	℗ Part No.	Description #	Note
W1	01801-61615	CABLE ASSY: CONSISTS OF W2 and W3	
W2	01801-61609	CABLE:COAX(FROM P1 TO J4)	
W3	01801-61611	CABLE:COAS(FROM P1 TO J4)	
W4	01801-61610	CABLE:COAX(FROM A4 TO A3)	
W4L1	9170-0029	CORE:FERRITE BEAD	
W4L2	9170-0029	CORE:FERRITE BEAD	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	℗ Part No.	Description #	Note
		OPT 001, 1801A REPLACEABLE PARTS LIST	
A3	01801-66539	BOARD ASSY:MAIN	
A3C43	0160-2234	C:FXD CER 0.51 ±0.25 PF 500VDCW	
A3C501	0140-0197	C:FXD MICA 180 PF 5% 300 VDCW	
A3C502	0140-0193	C:FXD MICA 82 PF 5% 300VDCW	
A3C503	0160-2244	C:FXD CER 3.0 ±0.25 PF 500VDCW	
A3C504	0160-2205	C:FXD MICA 120 PF 5% 300VDCW	
A3C505	0160-2203	C:FXD MICA 91 PF 5% 300VDCW	
A3CR501	1901-0040	DIODE:SILICON 30MA 30WV	
A3K501	0490-0909	RELAY:REED 1 FORM A	
A3K502	0490-0909	RELAY:REED 1 FORM A	
A3R501	0757-0419	R:FXD MET FLM 681 OHM 1% 1/8W	
A3R502	2100-2060	R:VAR FLM 50 OHM 20% LIN 1/2W	
A3R503	0757-0399	R:FXD MET FLM 82.5 OHM 1% 1/8W	
A3R504	0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W	
A3R505	0698-3435	R:FXD MET FLM 38.3 OHM 1% 1/8W	
A3R506	0757-0403	R:FXD MET FLM 121 OHM 1% 1/8W	
A5	01801-66537	BOARD ASSY:SYNC AMPL & VERT OUTPUT	
A5C501	0121-0046	C:VARI CER 9-35 PF	
A5C502	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A5C503	0180-0155	C:FXD ELECT 2.2 UF 20% 20VDCW	
A5C504	0180-0155	C:FXD ELECT 2.2 UF 20% 20VDCW	
A5C505	0150-0096	C:FXD CER 0.05 UF +80-20% 100VDCW	
A5L501	9100-2274	COIL:CHOKE 68 UH 10%	
A5L502	9100-2274	COIL:CHOKE 68 UH 10%	
A5Q501	1853-0026	Q:SI PNP	
A5R501	0757-0394	R:FXD MET FLM 51.1 OHM 1% 1/8W	
A5R502	0757-0284	R:FXD MET FLM 150 OHM 1% 1/8W	
A5R503	0757-0284	R:FXD MET FLM 150 OHM 1% 1/8W	
A5R504	0698-3438	R:FXD MET FLM 147 OHM 1% 1/8W	
A5R505	0757-0403	R:FXD MET FLM 121 OHM 1% 1/8W	
A5R506	0757-0403	R:FXD MET FLM 121 OHM 1% 1/8W	
A5R507	0757-0843	R:FXD MET FLM 15.0K OHM 1% 1/2W	
A5R508	0757-0394	R:FXD MET FLM 51.1 OHM 1% 1/8W	
A5R509	0698-3155	R:FXD MET FLM 4640 OHM 1% 1/8W	
A5R510	2100-2216	R:VAR FLM 5000 OHM 10% LIN 1/2W	
A5R511	0757-0190	R:FXD MET FLM 20K OHM 1% 1/2W	
A5R512	0757-0436	R:FXD MET FLM 4.32K OHM 1% 1/8W	
A5R513	0757-0284	R:FXD MET FLM 150 OHM 1% 1/8W	
A5R514	0757-0284	R:FXD MET FLM 150 OHM 1% 1/8W	
A5R515	0757-0817	R:FXD MET FLM 750 OHM 1% 1/2W	

 # See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	Part No.	Description #	Note
A5R516	0757-0274	R:FXD MET FLM 1.21K OHM 1% 1/8W	
A5R517	2100-1984	R: VAR FLM 100 OHM 10% LIN 1/2W	
A5R518	0698-3152	R:FXD MET FLM 3.48K 1%	
A5U501	1821-0002	TRANSISTOR ARRAY:SI NPN	
A5VR501	1902-0064	DIODE BREAKDOWN:7.5V 5%	
		OPT 001, CHASSIS PARTS	
A3	01801-66539	BOARD ASSY:MAIN	
A5	01801-66537	BOARD ASSY:SYNC AMPL & VERT OUTPUT	
J501		N.S.R. PART OF W501	
MP1	01801-00227	PANEL:FRONT	
MP2	01801-00226	PANEL:SUB	
MP13	01801-04105	COVER:SUPPORT	
R501		N.S.R. PART OF W501	
S501	3101-0070	SWITCH:SLIDE	
W1	01801-61616	CABLE:CONSIST OF W2 AND W3	
W501	01801-61614	CABLE:COAX(VERT OUTPUT) (VERT OUTPUT)INCL J501 & R501	

 # See introduction to this section for ordering information

Table 6-3. Replaceable Parts in HP Stock Number Order

℗ Part No.	Description #	Mfr.	Mfr. Part No.	TQ
0121-0046	C:VARI CER 9-35 PF	28480	0121-0046	†7
0121-0061	C:VAR CER 5.5-18 PF	72982	538-011-92A	1
0121-0168	C:VAR TEFLON 0.25-1.50 PF 600VDCW	28480	0121-0168	6
0121-0407	C:VAR TRIMMER 0.7-3.0 PF	72982	536-016	12
0121-0429	C:VAR POLY 0.7-3.0 PF	72982	536-009	4
0140-0193	C:FXD MICA 82 PF 5% 300VDCW	28480	0140-0193	†1
0140-0197	C:FXD MICA 180 PF 5% 300 VDCW	04062	RDM15F181J3C	†1
0140-0198	C:FXD MICA 200 PF 5% 300VDCW	72136	RDM15F201J3C	2
0140-0203	C:FXD MICA 30 PF 5% 500VDCW	28480	0140-0203	1
0140-0205	C:FXD MICA 62 PF 5% 300VDCW	28480	0140-0205	5
0140-0226	C:FXD MICA 320 PF 1% 300VDCW	28480	0140-0226	4
0140-0228	C:FXD MICA 360 PF 1% 300VDCW	28480	0140-0228	2
0150-0024	C:FXD CER 0.02 UF +80-20% 600VDCW	71590	TYPE DD 203	2
0150-0050	C:FXD CER DISC 1000 PF +80-20% 1000VDCW	56289	C067B102E102ZE19-CDH	8
0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA	†7
0150-0096	C:FXD CER 0.05 UF +80-20% 100VDCW	91418	TA	†1
0160-0153	C:FXD MY 0.001 UF 10% 200VDCW	56289	192P10292-PTS	6
0160-0161	C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS	1
0160-0168	C:FXD MICA 0.1 UF 10% 200VDCW	56289	192P10492-PTS	1
0160-0380	C:FXD MY 0.22 UF 10% 200VDCW	28480	0160-0380	1
0160-2145	C:FXD CER 5000 PF +80-20% 100VDCW	91418	TA	2
0160-2202	C:FXD MICA 75 PF 5% 300VDCW	28480	0160-2202	1
0160-2203	C:FXD MICA 91 PF 5% 300VDCW	72136	RDM15F910J3C	†1
0160-2204	C:FXD MICA 100PF 5% 300VDCW	72136	RDM15F101J3C	†2
0160-2205	C:FXD MICA 120 PF 5%300VDCW	28480	0160-2205	†1
0160-2234	C:FXD CER 0.51 PF ±0.25 PF 500 VDCW	72982	301-000-COKO-518C	†3
0160-2241	C:FXD CER 2.2 PF ±0.25 PF 500 VDCW	72982	301-000-COJO-229C	4
0160-2244	C:FXD CER 3.0 PF ±0.25 PF 500 VDCW	28480	0160-2244	†2
0160-2252	C:FXD CER 6.2 PF ±0.25PF 500VDCW	72982	301-NPO-6.2 PF	2
0160-2255	C:FXD CER 8.2 PF ±0.25PF 500VDCW	28480	0160-2255	1
0160-2257	C:FXD CER 10 PF 5% 500VDCW	72982	301-000-COHO-100J	3
0160-2261	C:FXD CER 15 PF 5% 500VDCW	72982	301-NPO-15 PF	2
0160-2262	C:FXD CER 16 PF 5% 500VDCW	72982	301-000 COGO 160J	2
0160-2263	C:FXD CER 18 PF 5% 500VDCW	72982	301-000-COGO-180J	2
0160-2264	C:FXD CER 20 PF 5% 500VDCW	72982	301-000-COGO-200J	1
0160-2307	C:FXD MICA 47 PF 5% 300VDCW	28480	0160-2307	2
0160-2474	C:FXD CER 14.2 PF 1% 500VDCW	72982	301-000-COGO-1429F	2
0160-2927	C:FXD CER 0.1UF 80%-20% 500VDCW	28480	0160-2927	
0160 3130	C:FXD MICA 100 PF 10% 250VDCW	72982	2933-003-18AQ 101K	2
0160-3463	C:FXD MICA 1000 PF 10% 250VDCW	72982	2933-003-102K	2
0170-0043	C:FXD MY 0.022UF 10% 600VDCW	24446	64FDA223	2
0180-0116	C:FXD ELECT 6.8 UF 10% 35VDCW	28480	0180-0116	2
0180-0155	C:FXD ELECT 2.2 UF 20% 20VDCW	56289	150D225X0020A2-DYS	†7
0180-0228	C:FXD ELECT 22 UF 10% 15VDCW	28480	0180-0228	2
0180-0230	C:FXD ELECT 1.0 UF 20% 50VDCW	28480	0180-0230	4
0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS	6
0340-0039	INSULATOR:BUSHING	28480	0340-0039	24
0340-0152	INSULATOR:TRANSISTOR	28480	0340-0152	4
0360-0124	TERMINAL:SOLDER LUG	28480	0360-0124	1
0370-0432	KNOB:BLACK LEVER	28480	0370-0432	2
0490-0909	RELAY:REED 1 FORM A	28480	0490-0909	†2
0698-0082	R:FXD MET FLM 464 OHM 1% 1/8W	14674	C4	1
0698-3109	R:FXD MET FLM 10.1K OHM 1% 1/8W	28480	0698-3109	2
0698-3132	R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132	4
0698-3146	R:FXD FLM 999K OHM 0.25% 1/4W	28480	0698-3146	2

See introduction to this section for ordering information † TQ includes Option 001

Table 6-3. Replaceable Parts in HP Stock Number Order (Cont'd)

℗ Part No.	Description #	Mfr.	Mfr. Part No.	TQ
0698-3152	R:FXD MET FLM 3.48K 1% 1/8W	14674	C4	†1
0698-3155	R:FXD MET FLM 4640 OHMS 1% 1/8W	28480	0698-3155	1
0698-3200	R:FXD FLM 8K OHM 1% 1/8W	28480	0698-3200	1
0698-3263	R:FXD MET FLM 500K OHM 1% 1/8W	28480	0698-3263	2
0698-3390	R:FXD MET FLM 19.6 OHM 1% 1/2W	28480	0698-3390	2
0698-3432	R:FXD MET FLM 26.1 OHM 1% 1/8W	28480	0698-3432	2
0698-3435	R:FXD MET FLM 38.3 OHM 1% 1/8W	28480	0698-3435	†1
0698-3438	R:FXD MET FLM 147 OHM 1% 1/8W	28480	0698-3438	†1
0698-3443	R:FXD MET FLM 287 OHM 1% 1/8W	91637	MF-1/10-32	4
0698-3444	R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444	4
0698-3445	R:FXD MET FLM 348 OHM 1% 1/8W	14674	C4	1
0698-3446	R:FXD MET FLM 383 OHM 1% 1/8W	14674	C4	3
0698-4037	R:FXD MET FLM 46.4 OHM 1% 1/8W	28480	0698-4037	4
0698-5470	R:FXD FLM 111K OHM 1% 1/8W	28480	0698-5470	2
0698-5471	R:FXD FLM 333K OHM 1% 1/8W	28480	0698-5471	2
0698-6400	R:FXD FLM 900K OHM 1.0% 1/4W	28480	0698-6400	2
0698-6634	R:FXD FLM 990K OHM 1.0% 1/4W	28480	0698-6634	2
0757-0190	R:FXD MET FLM 20K OHM 1% 1/2W	28480	0757-0190	†1
0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W	14674	C4	†1
0757-0274	R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274	†1
0757-0276	R:FXD MET FLM 61.9 OHM 1% 1/8W	28480	0757-0276	2
0757-0278	R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278	1
0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	14674	C4	3
0757-0281	R:FXD MET FLM 2.74K OHM 1% 1/8W	28480	0757-0281	4
0757-0282	R:FXD MET FLM 221 OHM 1% 1/8W	28480	0757-0282	8
0757-0283	R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283	4
0757-0284	R:FXD MET FLM 150 OHM 1% 1/8W	28480	0757-0284	†5
0757-0344	R:FXD MET FLM 1.00 MEGOHM 1% 1/4W	28480	0757-0344	4
0757-0346	R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346	2
0757-0382	R:FXD MET FLM 16.2 OHM 1% 1/8W	28480	0757-0382	2
0757-0388	R:FXD FLM 30.1 OHM 1% 1/8W	28480	0757-0388	6
0757-0393	R:FXD FLM 47.5 OHM 1% 1/8W	28480	0757-0393	1
0757-0394	R:FXD MET FLM 51.1 OHM 1% 1/8W	14674	C4	†2
0757-0397	R:FXD MET FLM 68.1 OHM 1% 1/8W	28480	0757-0397	2
0757-0398	R:FXD MET FLM 75 OHM 1% 1/8W	28480	0757-0398	1
0757-0399	R:FXD MET FLM 82.5 OHM 1% 1/8W	28480	0757-0399	†3
0757-0400	R:FXD MET FLM 90.9 OHM 1% 1/8W	01295	MC550	5
0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	14674	C4	6
0757-0403	R:FXD MET FLM 121 OHM 1% 1/8W	14674	C4	†4
0757-0407	R:FXD MET FLM 200 OHM 1% 1/8W	14674	C4	2
0757-0410	R:FXD MET FLM 301 OHM 1% 1/8W	28480	0757-0410	8
0757-0415	R:FXD MET FLM 475 OHM 1% 1/8W	28480	0757-0415	1
0757-0416	R:FXD MET FLM 511 OHM 1% 1/8W	14674	C4	2
0757-0417	R:FXD MET FLM 562 OHM 1% 1/8W	14674	C4	6
0757-0418	R:FXD MET FLM 619 OHM 1% 1/8W	14674	C4	2
0757-0421	R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421	†1
0757-0422	R:FXD MET FLM 909 OHM 1% 1/8W	28480	0757-0422	3
0757-0427	R:FXD MET FLM 1.5K 1% 1/8W	14674	C4	2
0757-0428	R:FXD MET FLM 1.62K 1% 1/8W	14674	C4	3
0757-0429	R:FXD MET FLM 1.82K OHM 1% 1/8W	28480	0757-0429	1
0757-0433	R:FXD MET FLM 3.32K OHM 1% 1/8W	28480	0757-0433	4
0757-0435	R:FXD FLM 3920 OHM 1% 1/8W	28480	0757-0435	4

See introduction to this section for ordering information † TQ includes Option 001

Table 6-3. Replaceable Parts in HP Stock Number Order (Cont'd)

℗ Part No.	Description #	Mfr.	Mfr. Part No.	TQ
0757-0436	R:FXD MET FLM 4.32K OHM 1% 1/8W	28480	0757-0436	†5
0757-0438	R:FXD MET FLM 5.11K 1% 1/8W	14674	C4	1
0757-0444	R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444	1
0757-0449	R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449	1
0757-0454	R:FXD MET FLM 33.2K OHM 1% 1/8W	28480	0757-0454	1
0757-0461	R:FXD MET FLM 68.1K OHM 1% 1/8W	91637	MF-1/10-32	2
0757-0475	R:FXD MET FLM 274K OHM 1% 1/8W	28480	0757-0475	2
0757-0486	R:FXD MET FLM 750K OHM 1% 1/8W	91637	MFF-1/8	2
0757-0714	R:FXD FLM 130 OHM 1% 1/4W	28480	0757-0714	1
0757-0715	R:FXD MET FLM 150 OHM 1% 1/4W	28480	0757-0715	1
0757-0719	R:FXD MET FLM 221 OHM 1% 1/4W	28480	0757-0719	1
0757-0723	R:FXD FLM 365 OHM 1% 1/4W	28480	0757-0723	2
0757-0728	R:FXD MET FLM 619 OHM 1% 1/4W	28480	0757-0728	1
0757-0732	R:FXD MET FLM 909 OHM 1% 1/4W	28480	0757-0732	2
0757-0735	R:FXD FLM 1.3K OHM 1% 1/4W	28480	0757-0735	2
0757-0805	R:FXD MET FLM 221 OHM 1% 1/2W	28480	0757-0805	2
0757-0817	R:FXD MET FLM 750 OHM 1% 1/2W	28480	0757-0817	†1
0757-0828	R:FXD MET FLM 3.01K OHM 1% 1/2W	28480	0757-0828	1
0757-0843	R:FXD MET FLM 15.0K OHM 1% 1/2W	28480	0757-0843	†1
0757-0893	R:FXD FLM 51 OHM 2% 1/8W	28480	0757-0893	4
0757-0839	R: FXD FLM 10K OHM 1% 1/2W	28480	0757-0839	1
0757-0897	R:FXD FLM 75 OHM 2% 1/8W	28480	0757-0897	5
0757-0900	R:FXD MET FLM 100 OHM 2% 1/8W	14674	C4	10
0757-0907	R:FXD FLM 200 OHM 2% 1/8W	28480	0757-0907	5
0757-0921	R:FXD MET FLM 750 OHM 2% 1/8W	14674	C4	1
0757-0922	R:FXD FLM 820 OHM 2% 1/8W	28480	0757-0922	1
0757-0924	R:FXD MET FLM 1K OHM 2% 1/8W	14674	C4	1
0757-0935	R:FXD FLM 3K OHM 2% 1/8W	28480	0757-0935	1
0757-0936	R:FXD FLM 3.3K OHM 2% 1/8W	28480	0757-0936	1
0757-0947	R:FXD FLM 9.1K OHM 2% 1/8W	28480	0757-0947	2
0757-1069	R:FXD MET FLM 388 OHM 1.0% 1/2W	28480	0757-1069	1
0761-0026	R:FXD MET OX 220 OHM 5% 1W	14674	C-32 OBD	1
0811-1153	R:FXD WW 360 OHM 1.0% 4W	28480	0811-1153	2
0811-2069	R:FXD WW 162 OHM 1% 3W	28480	0811-2069	2
0811-2548	R:FXD WW 750 OHM 1%	28480	0811-2548	2
1250-0001	CONNECTOR:BNC	28480	1250-0001	2
1250-0897	CONNECTOR:RF BULKHEAD JACK RECEPTACLE	98291	52-149-0000	1
1251-0198	CONNECTOR:P C 12 CONTACT	28480	1251-0198	1
1490-0968	BUSHING:POT (D.C.-BAL)	28480	1490-0968	2
1820-0352	INTEGRATED CIRCUIT:DIGITAL	01295	SN14291	3
1821-0002	TRANSISTOR ARRAY:SI NPN	02735	CA3045	†1
1853-0015	Q:SI PNP	04713	MPS3640-5	2
1853-0026	Q:SI PNP	04713	SM9105	†2
1853-0036	Q:SI PNP	04713	SPS 3612	1
1853-0203	Q: SI PNP	28480	1853-0203	5
1854-0019	Q:SI NPN(SELECTED FROM 2N2369)	28480	1854-0019	3
1854-0056	Q:SI NPN	02735	2N3119	2
1854-0091	Q:SI NPN(SIMILAR TO 2N3137)	28480	1854-0091	2
1854-0092	Q:SI NPN	07263	2N3563	4
1854-0215	Q:SI NPN	04713	SPS3611	3
1854-0345	Q:SI NPN	02735	2N5179	8
1901-0040	DIODE:SILICON 30MA 30WV	07263	FDG1088	†26
1901-0579	DIODE:SI(SPECIAL)	03508	SE 445	4
1902-0041	DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98	4

See introduction to this section for ordering information † TQ includes Option 001

Table 6-3. Replaceable Parts in HP Stock Number Order (Cont'd)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ
1902-0064	DIODE BREAKDOWN:7.5V 5%	28480	1902-0064	†1
1902-0074	DIODE:BREAKDOWN 7.15V 5%	04713	SZ10939-140	1
1902-0186	DIODE BREAKDOWN:32.4V 5% 400MW	28480	1902-0186	1
1902-3048	DIODE BREAKDOWN:SILICON 3.48V 5%	28480	1902-3048	1
2100-1738	R:VAR FLM 10K OHM 10% LIN 1/2W	28480	2100-1738	1
2100-1773	R:VAR WW 1K OHM 5% TYPE H 1W	28480	2100-1773	1
2100-1984	R:VAR FLM 100 OHM 10% LIN 1/2W	28480	2100-1984	
2100-1986	R:VAR CEMT 1K OHM 10% 1W	28480	2100-1986	†2
2100-2008	R:VAR COMP 10K OHM 10% 10CLOG 1/4W	28480	2100-2008	2
2100-2060	R:VAR FLM 50 OHM 20% LIN 1/2W	28480	2100-2060	†3
2100-2061	R:VAR FLM 200 OHM 10% LIN 1/2W	28480	2100-2061	3
2100-2062	R:VAR COMP 500 OHM 10% LIN 1/2W	28480	2100-2062	2
2100-2216	R:VAR FLM 5000 OHM 10% LIN 1/2W	28480	2100-2216	† 1
2100-2488	R:VAR COMP 10K OHM 10% LIN 3/4W	28480	2100-2488	2
2100-2887	R:VAR COMP 20K OHM 10% 1/4W	28480	2100-2887	2
2140-0018	LAMP:GLOW 1/10W	24455	NE 2E1	1
3100-2527	SWITCH:ROTARY 3 SECT 8 POSITION	28480	3100-2527	1
3100-2528	SWITCH:ROTARY 12 POSITION	28480	3100-2528	2
3100-2529	SWITCH:1 SECTION 3 POSITION	28480	3100-2529	2
3101-0070	SWITCH:SLIDE	79727	G-126	†3
5000-0543	SPRING:LEAF	28480	5000-0543	4
5020-0513	CONTACT:ELECTRICAL	28480	5020-0513	4
5040-0218	COUPLER:SWITCH SHAFT	28480	5040-0218	2
5060-0451	LENS ASSY	28480	5060-0451	1
5060-0458	HEADER:LAMP	28480	5060-0458	1
5080-0442	DIODE:SI MATCHED SET OF 8	28480	5080-0442	2
5080-0467	DIODE:MATCHED PAIR	28480	5080-0467	
5080-0494	Q: SI PNP MATCHED PAIR	28480	5080-0494	2
5080-0498	Q:FET(MATCHED PAIR)	28480	5080-0498	2
5080-9614	DIODE: (MATCHED SET OF 4)	28480	5080-9614	1
5080–9620	Q: SI NPN MATCHED QUAD	28480	5080–9620	1
5080–9621	Q: SI NPN MATCHED PAIR	28480	5080–9621	1
9100-1623	COIL:CHOKE 27 UH 5%	28480	9100-1623	3
9100-1631	COIL:CHOKE 56 UH 5%	28480	9100-1631	†4
9100-2252	COIL: CHOKE 0.27 UH 10%	28480	9100-2252	4
9100-2254	COIL: CHOKE .39 UH 10%	28480	9100-2254	4
9100-2274	COIL:CHOKE 68 UH 10%	28480	9100-2274	† 2
9140-0142	COIL:FXD RF 2.2 UH	28480	9140-0142	2
9140-0179	COIL: CHOKE 22.0 UH 10%	28480	9140-0179	6
9170-0029	CORE:FERRITE BEAD	02114	56-590-65A2/4A	2
00180-67402	KNOB: (VERNIER)	28480	00180-67402	2
01801-00221	PANEL:SUB	28480	01801-00221	1
01801-00222	PANEL:REAR	28480	01801-00222	1
01801-00223	PANEL:FRONT	28480	01801-00223	1
01801-00226	PANEL:SUB	28480	01801-00226	†1
01801-00227	PANEL:FRONT	28480	01801-00227	†1
01801-00606	SHIELD:ATTENUATOR "B"	28480	01801-00606	1
01801-00607	SHIELD:ATTENUATOR "A"	28480	01801-00607	1
01801-00608	SHIELD:OUTPUT	28480	01801-00608	1
01801-00609	SHIELD:ATTENUATOR BRACKET	28480	01801-00609	4
01801-01214	BRACKET(A1R14)	28480	01801-01214	1
01801-01215	BRACKET(A2R14)	28480	01801-01215	1
01801-01219	BRACKET:MAIN	28480	01801-01219	1
01801-04104	COVER:SUPPORT	28480	01801-04104	1
01801-04105	COVER:SUPPORT	28480	01801-04105	†1
01801-04703	SUPPORT:PLUG-IN	28480	01801-04703	1
01801-23206	SHAFT:VERNIER	28480	01801-23206	2

See introduction to this section for ordering information † TQ includes Option 001

Table 6-3. Replaceable Parts in HP Stock Number Order (Cont'd)

℗ Part No.	Description #	Mfr.	Mfr. Part No.	TQ
01801-26506	P:SLIDE 2 PIN	28480	01801-26506	1
01801-27601	P:MALE 24 PIN	28480	01801-27601	1
01801-60101	CHASSIS ASSY:LEFT	28480	01801-60101	1
01801-61203	BRACKET:ATTENUATOR "A"	28480	61203	1
01801-61204	BRACKET:ATTENUATOR "B"	28480	01801-61204	1
01801–61615	CABLE ASSY:CONSISTS OF W2 AND W3	28480	01801–61615	1
01801-61609	CABLE:COAX(FROM P2 TO J4)	28480	01801-61609	1
01801-61610	CABLE:COAX(FROM A4 TO A3)	28480	01801-61610	1
01801-61611	CABLE:COAX(FROM P2 TO J4)	28480	01801-61611	1
01801-61614	CABLE:COAX(VERT OUTPUT)	28480	01801-61614	†1
01801-63407	ASSY:ATTENUATOR "A"	28480	01801-63407	1
01801-63408	ASSY:ATTENUATOR "B"	28480	01801-63408	1
01801-66530	BOARD ASSY:MULTIVIBRATOR	28480	01801-66530	1
01801-66531	DELAY LINE:DUAL 162 NS	28480	01801-66531	1
01801-66536	BOARD ASSY:SYNC AMPLIFIER	28480	01801-66536	1
01801-66538	BOARD ASSY:MAIN	28480	01801-66538	1
01801-66539	BOARD ASSY:MAIN	28480	01801-66539	†1
01801-66537	BOARD ASSY:SYNC AMPL & VERT OUTPUT	28480	01801-66537	†1
01801-67401	KNOB:BLACK(CAL)	28480	01801-67401	2
01801-67403	KNOB:BLACK(VOLTS/DIV)	28480	01801-67403	2
01801-67404	KNOB:VERTICAL DISPLAY	28480	01801-67404	1
1490-0968	BUSHING:POT(DC-BAL)	28480	01490-0968	4
1750A-64A	HOLDER:TRIMMER	28480	1750A-64A	4

See introduction to this section for ordering information † TQ includes Option 001

Table 6-4. List of Manufacturers' Codes

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer	Address
00000	U.S.A Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00287	Cemco, Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Mictron, Co., Inc.	Valley Stream, N.Y.
00373	Garlock Inc.	Cherry Hill, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp. Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00809	Croven, Ltd.	Whitby, Ontario, Canada
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S.C.
00866	Goe Engineering Co.	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Cal.
00929	Microlab Inc.	Livingston, N.J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N.Y.
01009	Alden Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Cal.
01281	TRW Semiconductors, Inc.	Lawndale, Cal.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co	Alliance, Ohio
01538	Small Parts Inc.	Los Angeles, Cal.
01589	Pacific Relays, Inc.	Van Nuys, Cal.
01670	Gudebrod Bros. Silk Co.	New York, N.Y.
01930	Amerock Corp.	Rockford, Ill.
01960	Pulse Engineering Co	Santa Clara, Cal.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02116	Wheelock Signals, Inc.	Long Branch, N.J.
02286	Cole Rubber and Plastics Inc	Sunnyvale, Cal.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Division	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins EngineeringCo.	San Fernando, Cal.
02875	Hudson Tool & Die	Newark, N.J.
03296	Nylon Molding Corp.	Springfield, N.J.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03818	Parker Seal Co.	Los Angeles, Cal.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div., Finderne Plant	Sumerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taruus Corp.	Lambertville, N.J.
04062	Arco Electronic Inc.	Great Neck, N.Y.
04217	Essex Wire	Los Angeles, Cal.
04222	Hi-Q Division of Aerovox.	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Wheeling, Ill.
04404	Palo Alto Division of Hewlett-Packard Co.	Palo Alto, Cal.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Cal.
04673	Dakota Engr. Inc.	Culver City, Cal.
04713	Motorola Inc. Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Cal.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Cal.
04811	Precision Coil Spring Co.	El Monte, Cal.
04870	P.M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Cal.
05277	Westinghouse Electric Corp. Semiconductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Cal.
05397	Union Carbine Corp., Elect. Div.	New York, N.Y.
05574	Viking Ind. Inc.	Canoga Park, Cal.
05593	Icore Electro-Plastics Inc.	Sunnyvale, Cal.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Westbury, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Cal.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Cal.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Components Inc., Ariz. Div.	Phoenix, Arizona
06812	Torrington Mfg. Co., West Div.	Van Nuys, Cal.
06980	Varian Assoc. Etmac Div.	San Carlos, Cal.
07088	Kelvin Electric Co.	Van Nuys, Cal.
07126	Digitran Co.	Pasadena, Cal.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp., Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Cal.
07256	Silicon Transistor Corp.	Carle Place, N.Y.
07261	Avnet Corp.	Culver City, Cal.
07263	Fairchild Camera & Inst. Corp., Semiconductor Div.	Mountain View, Cal.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Birtcher Corp, The	Monterey Park, Cal.
07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Cal.
07700	Technical Wire Products Inc.	Cranford, N.J.
07829	Bodine Elect. Co.	Chicago, Ill.
07910	Continental Device Corp.	Hawthorne, Cal.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Cal.
07980	Hewlett-Packard Co., New Jersey Division	Rockaway, N.J.
08145	U.S. Engineering Co.	Los Angeles, Cal.
08289	Blinn, Delbert Co.	Pomona, Cal.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Cal.
08664	Bristol Co., The	Waterbury, Conn
08717	Sloan Company	Sun Valley, Cal.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab. Inc.	Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div. of CBS Inc	Lowell, Mass.
08806	General Electric Co., Miniature Lamp Dept.	Cleveland, Ohio
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Cal.
09097	Electronic Enclosures Inc.	Los Angeles, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Cal.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09353	C & K Components Inc.	Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09795	Pennsylvania Florocarbon.	Clifton Heights, Penn.
09922	Burndy Corp	Norwalk, Conn.
10214	General Transistor Western Corp.	Los Angeles, Cal.
10411	Ti-Tal, Inc.	Berkeley, Cal.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Cal.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Cal.
11314	National Seal	Downey, Cal.
11453	Precision Connector Corp.	Jamaica, N.Y.
11534	Duncan Electronics Inc.	Costa Mesa, Cal.
11711	General Instrument Corp., Semiconductor Division Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Cal.
11870	Melabs, Inc.	Palo Alto, Cal.
12136	Philadelphia Handle Co.	Camden, N.J.
12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12574	Gulton Ind. Inc., Data System Div.	Albuquerque, N.M.
12697	Clarostat Mfg. Co.	Dover, N.H.
12728	Elmar Filter Corp	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Cal.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13019	Airco Supply Co., Inc.	Witchita, Kansas
13061	Wilco Products	Detroit, Mich.
13103	Thermolloy	Dallas, Texas
13327	Solitron Devices Inc.	Tappan, N.Y.
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Cal.
14193	Calif. Resistor Corp	Santa Monica, Cal.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, a Div. of Int. Telephone and Telegraph Corporation	West Palm Beach, Fla.
14493	Hewlett-Packard Company.	Loveland, Colo.
14655	Cornell Dublier Electric Corp	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc.	San Gabriel, Cal.
14960	Williams Mfg. Co.	San Jose, Cal.
15106	The Sphere Co., Inc.	Little Falls, N.J.
15203	Webster Electronics Co.	New York, N.Y.
15287	Scionics Corp.	Northridge, Cal.
15291	Adjustable Bushing Co.	N. Hollywood, Cal.
15558	Micron Electronics.	Garden City, Long Island, N.Y.
15566	Amprobe Inst. Corp.	Lynbrook, N.Y.
15631	Cabletronics	Costa Mesa, Cal.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Cal.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Amelco Inc.	Mountain View, Cal.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16179	Omni-Spectra Inc.	Detroit, Ill.
16352	Computer Diode Corp.	Lodi, N.J.
16554	Electroid Co.	Union, N.J.
16585	Boots Aircraft Nut Corp.	Pasadena, Cal.
16688	Ideal Prec. Meter Co., Inc., De Jur Meter Div.	Brooklyn, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics Inc.	Canoga Park, Cal.
17474	Tranex Company	Mountain View, Cal.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Cal.
17856	Siliconix Inc.	Sunnyvale, Cal.
17870	McGraw-Edison Co.	Manchester, N.H.
18042	Power Design Pacific Inc.	Palo Alto, Cal.
18083	Clevite Corp. Semiconductor Div.	Palo Alto, Cal.
18324	Signetics Corp.	Sunnyvale, Cal.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18565	Chomerics	Plainville, Mass.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.	Malvern, Pa.
18873	E.I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison	West Orange, N.J.
19589	Concoa	Baldwin Park, Cal.

Table 6-4. List of Manufacturers' Codes (Continued)

Code No.	Manufacturer	Address
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21355	Fafnir Bearing Co., The	New Britian, Conn.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
23020	General Reed Co.	Metuchen, N.J.
23042	Texscan Corp.	Indianapolis, Ind.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division, Nela Park,	Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobert File Co. of America, Inc.	Carlstadt, N.J.
26851	Compac/Hollister Co.	Hollister, Cal.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Cal.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
30817	Instrument Specialties Co., Inc.	Little Falls, N.J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products, Ltd.	Hawkesbury, Ontario, Canada
36287	Cunningham, W.H. & Hill, Ltd.	Toronto, Ontario, Canada
37942	P.R. Mallory & Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
40931	Honeywell Inc.	Minneapolis, Minn.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	HP Co., Med. Elec. Div.	Waltham, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & System Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
58474	Superior Elect. Co.	Bristol, Conn.
59446	Telex Corp.	Tulsa, Okla.
59730	Thomas & Betts Co.	Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark	Newark, N.J.
66295	Wittek Mfg. Co.	Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N.J.
70674	ADC Products Inc.	Minneapolis, Minn.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electric Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Bliley Electric Co., Inc.	Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincey, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst, L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Cal.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Cal.
71471	Cinema, Div. Aerovox Corp.	Burbank, Cal.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	Cornish Wire Co., The	New York, N.Y.
71707	Coto Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap Division	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72962	Elastic Stop Nut Corp.	Union, N.J.
72964	Robert M. Hadley Co.	Los Angeles, Cal.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Cal.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Cal.
73445	Amperex Elect. Co.	Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries, Inc.	Philadelphia, Pa.
73734	Federal Screw Products, Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Cal.
73957	Groove-Pin Corp.	Ridgefield, N.J.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronic Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.	St. Marys, Pa.
75378	CTS Knights, Inc.	Sandwich, Ill.
75382	Kulka Electric Corp.	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Cal.
76433	General Instrument Corp., Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Cal.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Cal.
76545	Mueller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Cal.
77075	Pacific Metals Co.	San Francisco, Cal.
77221	Phaostran Instrument and Electronic Co.	So. Pasadena, Cal.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Division	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Cal.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Cal.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Cal.
78947	Ucinite Co.	Newtonville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80033	Prestole Corp.	Toledo, Ohio
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80131	Electronic Industries Association. Standard tube or semi-conductor device, any manufacturer.	
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Inc.	Riverside, Cal.
80411	Arco Div. of Robertshaw Controls Co.	Columbus, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Cal.
80583	Hammarlund Co., Inc.	Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
80813	Dimco Gray Co.	Dayton, Ohio
81030	International Inst. Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Cal.
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Military Specification	
81483	International Rectifier Corp.	El Segundo, Cal.
81541	Airpax Electronics, Inc.	Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
82042	Carter Precision Electric Co.	Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N.J.
82116	Electric Regulator Corp.	Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp., Space & Defense Systems Div.	Paramus, N.J.
82209	Magurie Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod., Inc. Electronic Tube Division	Emporium, Pa.
82376	Astron Corp.	East Newark, Harrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc., Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rolton Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Cal.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Cal.
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83324	Rosan Inc.	Newport Beach, Cal.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisades Park, N.J.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp., Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
83942	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Cal.
84411	TRW Capacitor Div.	Ogallala, Neb.

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Table 6-4. List of Manuracturers' Codes (Continued)

Code No.	Manufacturer	Address
94870	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A. B. Boyd Co.	San Francisco, Cal.
85474	R. M. Bracamonte & Co.	San Francisco, Cal.
85660	Koiled Kords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86174	Fafnir Bearing Co.	Los Angeles, Calif.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Division	Harrison, N.J.
86928	Seastrom Mfg. Co.	Glendale, Cal.
87034	Marco Industries	Anaheim, Cal.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Cal.
87664	Van Waters & Rogers Inc.	San Francisco, Cal.
87930	Tower Mfg. Corp.	Providence, R.I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Co.	Oakland, Cal.
89473	G.E. Distributing Corp.	Schenectady, N.Y.
89479	Security Co.	Detroit, Mich.
89665	United Transformer Co.	Chicago, Ill.
90030	United Shoe Machinery Corp.	Beverly, Mass.
90179	U.S. Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90365	Belleville Speciality Tool Mfg., Inc.	Belleville, Ill.
90763	United Carr Fastener Corp.	Chicago, Ill.
90970	Bearing Engineering Co.	San Francisco, Cal.
91146	ITT Cannon Elect. Inc., Salem Div.	Salem, Mass.
91260	Connor Spring Mfg. Co.	San Francisco, Cal.
91345	Miller Dial & Nameplate Co.	El Monte, Cal.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91673	Epiphone Inc.	New York, N.Y.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Cal.
91886	Malco Mfg., Inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Division	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Cal.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co., Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
92702	IMC Magnetics Corp.	Westbury, L.I., N.Y.
92966	Hudson Lamp Co.	Kearney, N.J.
93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Pallisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.	Mansfield, Ohio
93632	Waters Mfg. Co.	Culver City, Cal.
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N.J.
94197	Curtiss-Wright Corp., Electronics Div.	East Patterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94375	Automatic Metal Products Co.	Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95146	Alco Elect. Mfg. Co.	Lawrence, Mass.
95236	Allies Products Corp.	Diania, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95566	Arnold Engineering Co.	Marengo, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Siemon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Microwave Assoc., West, Inc.	Sunnyvale, Cal.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Mfg. Co.	Los Angeles, Cal.
96396	Microswitch, Div. of Minn.-Honeywell	Freeport, Ill.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Cal.
96508	Xcelite, Inc.	Orchard Park, N.Y.
96733	San Fernando Elec. Mfg. Co.	San Fernando, Cal.
96881	Thomson Ind. Inc.	Long Island, N.Y.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
98141	R-Tronics, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Cal.
98220	Hewlett-Packard Co., Medical Elec. Div.	Pasadena, Cal.
98278	Microdot, Inc.	So. Pasadena, Cal.
98291	Sealectro Corp.	Mamaronech, N.Y.
98376	Zero Mfg. Co.	Burbank, Cal.
98410	Etc Inc.	Cleveland, Ohio
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Division of Hewlett-Packard Co.	Palo Alto, Cal.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Cal.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Cal.
99378	Atlee Corp.	Winchester, Mass.
99515	Marshall Ind., Capacitor Div.	Monrovia, Cal.
99707	Control Switch Division, Controls Co. of America	El Segundo, Cal.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99928	Branson Corp.	Whippany, N.J.
99934	Rembrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp., Semiconductor Division	El Monte, Cal.
99957	Technology-Instrument Corp. of California	Newbury Park, Cal.

The following HP Vendors have no number assigned in the latest supplement to the Federal Supply Code for Manufacturers Handbook.

0000F	Malco Tool and Die	Los Angeles, Calif.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AB	ETA	England
000BB	Precision Instrument Comp. Co.	Van Nuys, Cal.
000CS	Hewlett-Packard Co., Colorado Springs Div.	Colorado Springs, Colorado
000MM	Rubber Eng. & Development	Hayward, Cal.
000NN	A "N" D Mfg. Co.	San Jose, Cal.
000QQ	Cooltron	Oakland, Cal.
000WW	California Eastern Lab	Burlington, Cal.
000YY	S.K. Smith Co.	Los Angeles, Cal.

SECTION VII

MANUAL CHANGES AND OPTIONS

7-1. INTRODUCTION.

7-2. This section contains information required to backdate or update this manual for a specific instrument. Descriptions of special instruments and option instruments are also in this section.

7-3. MANUAL CHANGES.

7-4. This manual applies directly to the standard Model 1801A (as manufactured) with a serial prefix as shown on the title page. The following paragraphs explain how to adapt this manual for instruments with different serial prefix numbers. Corrections to this manual (if any) are called ERRATA and are listed in a separate MANUAL CHANGES sheet supplied with this manual.

7-5. If the serial prefix of the Model 1801A is above that shown on the title page, refer to the separate MANUAL CHANGES sheet supplied with this manual. Locate the serial prefix of the instrument and make the indicated changes to the manual.

7-6. If the serial prefix of the Model 1801A is below 936—, operating, service and adjustment information is contained in a previous edition of this manual. If the serial prefix of the instrument is between 936— and the number shown on the title page, refer to Table 7-1 for the changes necessary to adapt this manual to the particular instrument. Contact the nearest HP Sales/ Service Office to obtain data applicable to the instrument. Be sure to refer to the serial prefix of the instrument.

Table 7-1. Manual Changes

Instrument	Make Changes
936—	1,2,3,4,5,6
949—	2,3,4,5,6
951—	3,4,5,6
966—, 969—	4,5,6
1130A,	5,6
1132A	5,6
1214A	6
1220A	6

CHANGE 1

Table 6-2,
Delete: A3R117 and A3R118.
Add A3L9, A3L14: HP Part No. 9140-0179; TQ 6; L: fxd 22 uH 10%.

CHANGE 1 (Cont'd)

Table 6-3,
Delete: 0757-0346.
9140-0179: Change TQ to 8.
Page 8-9, Figure 8-12,
Replace R117 and R118 with L9 and L14 respectively. L9 and L14 are 22 uH inductors.

CHANGE 2

Table 6-2,
A1C4, A2C4: Change to HP Part No. 0160-2259; TQ2; C: fxd cer 12 pF 5% 500 WVDC.
A1C8, A2C8: Change to HP Part No. 0160-2260; TQ2; C: fxd cer 13 pF 5% 500 WVDC.
A1C12, A2C12: Change to HP Part No. 0160-2474; TQ2; C: fxd cer 14.2 pF 1% 500 WVDC.
A1C20, A2C20: Change to HP Part No. 0160-2250; TQ2; C: fxd cer 5.1 pF ±0.25 pF 500 WVDC.
Table 6-3,
Add 0160-2250: C: fxd cer 5.1 pF ±0.25 pF 500 WVDC; Mfr. 28480 Mfr. Part No. 0160-2250, TQ2.
Delete: 0160-2252
Add 0160-2259: C: fxd cer 12 pF 5% 500 WVDC; Mfr. 28480 Mfr. Part No. 0160-2259, TQ2.
Add 0160-2260; C: fxd cer 13 pF 5% 500 WVDC; Mfr. 28480 Mfr. Part No. 0160-2260, TQ2.
Delete: 0160-2261
Page 8-5, Figure 8-5,
Change value of A1C4 and A2C4 to 12 pF.
Change value of A1C8 and A2C8 to 13 pF.
Change value of A1C12 and A2C12 to 14.2 pF.
Change value of A1C20 and A2C20 to 5.1 pF.

CHANGE 3

Table 6-2,
A3: Change to HP Part No. 01801-66528.
A5: Change to HP Part No. 01801-66527.
Delete: A3R119-A3R122.
Delete: A3CR29-A3CR32.
A5R3-R8: Change to HP Part No. 0757-0803; R: fxd metflm 182 ohms 1% 1/2W.
A5R14: Change to HP Part No. 0757-0401; R: fxd metflm 100 ohms 1% 1/2W.
A5R18: Change to HP Part No. 0757-0410; R: fxd metflm 301 ohms 1% 1/8W.
Add H3 and H4; HP Part No. 1490-0848; Bushing: pot 1/4-32 Ext Thread (CAL).
Add H5 and H6; HP Part No. 01801-23701; Shaft: Cal.
Add H7 and H8; HP Part No. 1490-0841; Coupling: Shaft 0.127-in. ID.
Delete H18 and H19.

CHANGE 3 (Cont'd)

Table 6-3,
0698-3446: Change TQ to 2.
Delete: 0757-0398.
0757-0401: Change TQ to 7.
0757-0410: Change TQ to 9.
0757-0436: Change TQ to 1.
Add 0757-0803: R: fxd metflm 182 ohms 1% 1/2W; Mfr. 28480 Mfr. Part No. 0757-0803.
Delete: 0757-0805.
Delete: 1490-0841:
Delete: 1490-0848.
1901-0040: Change TQ to 22.
Delete: 0180-23701.
Add 01801-66527: Board Assy: Sync Amplifier Mfr. 28480 Mfr. Part No. 01801-66527.
Add 01801-66528: Board Assy: Main; Mfr. 28480 Mfr Part No. 01801-66528.
Delete: 01801-66532.
Delete: 01801-66533.
01821-21702: Change TQ to 2.
Figure 8-8, Page 8-7,
Remove A3R119-R122 and A3CR29-CR32.
Figure 8-20, Page 8-13,
Change value of A5R3 and R8 to 182.
Change value of A5R14 to 100.
Change value of A5R18 to 301.

CHANGE 4

Table 6-2,
A4C6: Change to HP Part No. 0180-0230; C:FXD ELECT 1.0UF 20% 50VDCW.
Q1: Change to HP Part No. 1854-0091; Q:SI NPN.
Q2: Change to HP Part No. 1854-0091; Q:SI NPN.
Page 8-11,
Figure 8-16: Change value of A4C6 to 1.0UF.

CHANGE 5

Table 6-2,
Add: A1R1 HP Part No. 0698-3390; R: fxd metflm 19.6 ohms 1% 1/2W.
A1R8: Change to HP Part No. 0698-3432; R: fxd metflm 26.1 ohms 1% 1/8W.
Add: A2R1 HP Part No. 0698-3390; R: fxd metflm 19.6 ohms 1% 1/2W.
A2R8: Change to HP Part No. 0698-3432; R: fxd metflm 26.1 ohms 1% 1/2W.
Replace figure 8-8 with figure 7-5.

CHANGE 6

Table 6-2,
A3: Change to HP Part No. 01801-66533.
Add: A3R15 HP Part No. 2100-1984, R:VAR FLM 100 ohms 10% LIN 1/2W.

CHANGE 6 (Cont'd)

A3R16: Change to HP Part No. 0757-0420; R: fxd metflm 750 ohms 1% 1/8W.
A3R17: Change to HP Part No. 0757-0420; R: fxd metflm 750 ohms 1% 1/8W.
Add: A3R55 HP Part No. 2100-1984; R:VAR FLM 100 ohms 10% LIN 1/2W.
A3R56: Change to HP Part No. 0757-0420; R: fxd metflm 750 ohms 1% 1/8W.
A3R57: Change to HP Part No. 97
A3R57: Change to HP Part No. 0757-0420; R: fxd metflm 750 ohms 1% 1/8W.
Delete: W4L1
Delete: W4L2
Replace A5 Replaceable Parts list with table 7-3
W1: Change to HP Part No. 01801-61608.
Table 6-2, OPT 0001,
A3: Change to HP Part No. 01801-66534
A5: Change to HP Part No. 01801-66535
A5R509: Change to HP Part No. 0757-0434; R: fxd metflm, 3.65K ohms 1% 1/8W.
A5R510: Change to HP Part No. 2100-2497 R:VAR MET FLM 3.65K ohms, 1% 1/8W.
Figure 8-17,
Replace with figure 7-6.
Figure 8-19,
Replace with figure 7-7.
Figure 8-20,
Replace with figure 7-8.

7-7. OPTIONS.

7-8. Options are standard modifications performed on HP instruments at the factory. There are three options available for the Model 1801A.

7-9. OPTION 001.

7-9A. OPTION 003.

7-9B. Model 10004B probes not supplied.

7-10. This option provides a Channel B vertical output signal at the front panel and times-five magnification for the vertical signal. Refer to Paragraphs 7-17 through 7-35 for operating, maintenance and parts information.

7-11. OPTION 090.

7-12. This option replaces the two standard Model 10004B Probes with Model 10006B (6 ft) 10:1 Voltage Divider Probes. Refer to Appendix 1 for complete information.

7-13. OPTION 091.

7-14. This option replaces the two standard Model 10004B Probes with Model 10005B (10 ft) 10:1 Voltage Divider Probes. Refer to Appendix 1 for complete information.

7-15. SPECIAL INSTRUMENTS.

7-16. Special instruments are standard HP instruments modified at the factory according to customer specifications. These instruments are identified with a special prefix to the instrument model number. A separate insert sheet is included with the manual for each instrument that has been modified in a manner which alters operation, instrument specifications or replaceable parts. The insert describes both the modification and required changes to this manual.

7-17. MODEL 1801A/OPTION 001.

7-18. Model 1801A Option 001 is a standard instrument in which X5 magnifier circuitry and vertical output circuitry are added. The X5 magnifier circuitry increases the gain of the main amplifier by a factor of five. Bandwidth for X5 operation is 20 MHz with risetime of less than 18 ns.

7-19. The vertical output provides a signal output from Channel B. The output signal can be applied to Channel A input for additional gain. The additional gain is 10 when output is terminated into 50-ohm load. Bandwidth is greater than 30 MHz with risetime less than 12 ns. Refer to Table 7-2 for specifications of Option 001 which are in addition to specifications in Section I of this manual.

Table 7-2. Model 1801A/Option 001 Specifications

X5 Magnification:
Bandwidth: dc to 20 MHz.
Risetime: less than 18 ns.
Vertical Output:
Bandwidth: dc to 40 MHz.
Risetime: less than 9 ns.
Gain: when terminated by 50 ohms, gain is 10.
For Cascode Operation: Bandwidth is greater than 30 MHz, risetime is less than 12 ns.

7-20. PRINCIPLES OF OPERATION.

7-21. X5 OPERATION.

7-22. The X5 operation is accomplished in the main amplifier and controls the gain in all display modes: A, B, A + B, CHOP, and ALT. Switch S501 controls the gain of differential amplifier A3Q23 and A3Q24 and differential cascode amplifier Q1 through Q4. When switch S501 is set to X5, relays A3K501 and K502 close and decrease the emitter resistances of the two amplifiers. This decreases the amount of emitter degeneration and increases the total gain of the two amplifiers by five. The schematic of X5 magnifier circuit, is located in Figure 7-2 and component location in Figure 7-1.

7-23. VERTICAL OUTPUT.

7-24. The vertical signal is picked off differentially across Channel B preamplifier. One signal comes from the emitter of A3Q17 at the sync amplifier input for Channel B (A5R6). The other signal comes from junction of A3CR32 and A3R122 on assembly A3. The two signals are identical and 180 degrees out of phase. They are coupled to differential amplifier A5U501Q1 and Q2. The output is taken from A5U501Q2 and coupled to common emitter amplifier A5U501Q3. Capacitor A5C501 is the pulse response adjustment for ensuring maximum bandwidth ($>$ 40 MHz). Transistors A5U501Q4 and A5Q501 make up the feedback pairs, characterized by stable gain over a wide frequency range. The signal at the collector of A5Q501 is in phase with the base of A5U501Q3. It is fed back through emitter follower A5U501Q4 to the emitter of A5U501Q3 as negative feedback. Base-to-emitter voltage differences in A1U501Q3 are temperature compensated by the differential configuration of A5U501Q3 and Q4. Adjustment A5R510 is used to set the dc output level for 0 volt. Adjustment A5R517 is used to set gain of the amplifier when terminated into 50 ohms. The schematic of Channel B vertical amplifier is located in Figure 7-4 and component location in Figure 7-3.

7-25. PERFORMANCE CHECK AND ADJUSTMENTS.

7-26. The following performance check and adjustment procedure is supplementary to procedure in Section V. Refer to Section V for introductory information and required test equipment. A DC Voltmeter (similar to HP Model 412A) with 0V ± 3% capability is required in addition to the equipment listed in Table 5-1. Perform the performance check and adjustment procedures in Section V including the following steps where applicable.

7-27. PERFORMANCE CHECK, OPTION 001.

7-28. DEFLECTION FACTOR. After completing deflection factor check in Section V, proceed as follows:

a. Set Voltmeter Calibrator to 0.5V.

b. Set Channel B VOLTS/DIV to .5, and MAGNIFIER to X5. Display height should be 5 div ± 0.15 div.

c. Set MAGNIFIER to X1, and set Channel B VOLTS/DIV to 20.

7-29. BANDWIDTH. After completing Bandwidth check in Section V, proceed as follows:

a. Set Constant Amplitude Signal Generator for 50 kHz.

b. Set MAGNIFIER to X5 and adjust Channel B Vernier for 8 div. Note RF Voltmeter indication.

c. Set Constant Amplitude Signal Generator Frequency to 20 MHz and amplitude to same level noted above. Observe more than 5.7 div of vertical deflection.

d. Set Vertical DISPLAY to A.

e. Connect Constant Amplitude Signal Generator to Channel A INPUT.

f. Repeat above procedure for Channel A.

g. Disconnect Constant Amplitude Signal Generator.

7-30. RISETIME. After completing Risetime check in Section V, proceed as follows:

a. Set MAGNIFIER to X5.

b. Adjust amplitude of Pulse Generator for 8 div of vertical display. Use an attenuator similar to HP 355C, variable from 0 to 40 dB, to obtaining 8 div of vertical deflection. Observe risetime of less than 18 ns.

c. Set MAGNIFIER to X1.

d. Set Vertical DISPLAY to Channel A.

e. Connect VERT OUTPUT CHAN B to Channel A INPUT using 50-ohm load for Channel A INPUT.

f. Set Channel A VOLTS/DIV and Vernier for 8 div of deflection on face of CRT. Observe risetime of less than 12 ns.

g. Disconnect Pulse Generator from Channel B INPUT and connect it to Channel A INPUT.

h. Set MAGNIFIER to X5.

i. Readjust pulse Generator for 8 div of vertical deflection on face of CRT. Observe risetime of less than 15 ns.

j. Set MAGNIFIER to X1.

k. Disconnect Pulse Generator.

7-31. ADJUSTMENTS, OPTION 001.

7-32. GAIN. After completing Gain adjustment in Section V, proceed as follows:

a. Set Vertical DISPLAY to Channel B.

b. Set B POLARITY to +UP.

c. Disconnect Voltmeter Calibrator.

d. Center Channel B trace.

e. Monitor VERT OUTPUT CHANNEL B with DC Voltmeter and adjust A5R510 for 0 volt.

f. Connect Voltmeter Calibrator Channel B INPUT.

g. Connect VERT OUTPUT CHANNEL B to Channel A INPUT with 50-ohm load.

h. Set Vertical DISPLAY to A.

i. Set Channel B VOLTS/DIV to 0.05.

j. Set A5R517 for 6 div of vertical deflection.

k. Set Channel A VOLTS/DIV for 0.05.

l. Set MAGNIFIER for X5.

m. Adjust A3R502 for 3 div of vertical deflection.

n. Disconnect Voltmeter Calibrator.

o. Set MAGNIFIER to X1.

p. Set A and B VOLTS/DIV to .005.

NOTE

Use an attenuator or voltage divider with some signal sources to reduce signal to noise ratio. 20 dB (10:1) or 40 dB (100:1) attenuators with greater than 1% accuracy are satisfactory.

7-33. PULSE RESPONSE. After completing Pulse Response adjustment in Section V, proceed as follows:

a. Set MAGNIFIER to X5.

b. Adjust Pulse Generator output amplitude for 8 div of vertical deflection. (Use an attenuator similar to (HP 355C, variable from 0 to 40 dB, to obtain 8 div of vertical deflection). Observe risetime of less than 18 ns.

c. Set MAGNIFIER to X1.

d. Adjust Pulse Generator output amplitude for 8 div of vertical deflection.

e. Connect VERT OUTPUT CHAN B to Channel A INPUT with 50-ohm load.

f. Set Vertical DISPLAY to Channel A.

g. Set Channel B VOLTS/DIV to 0.05.

h. Adjust A5R501 for best pulse response. Observe risetime of less than 12 ns.

NOTE

If the above checks or adjustments can not be accomplished, readjustment of main amplifier may be necessary. Repeat Pulse Response adjustment in Section V if required.

7-34. REPLACEABLE PARTS.

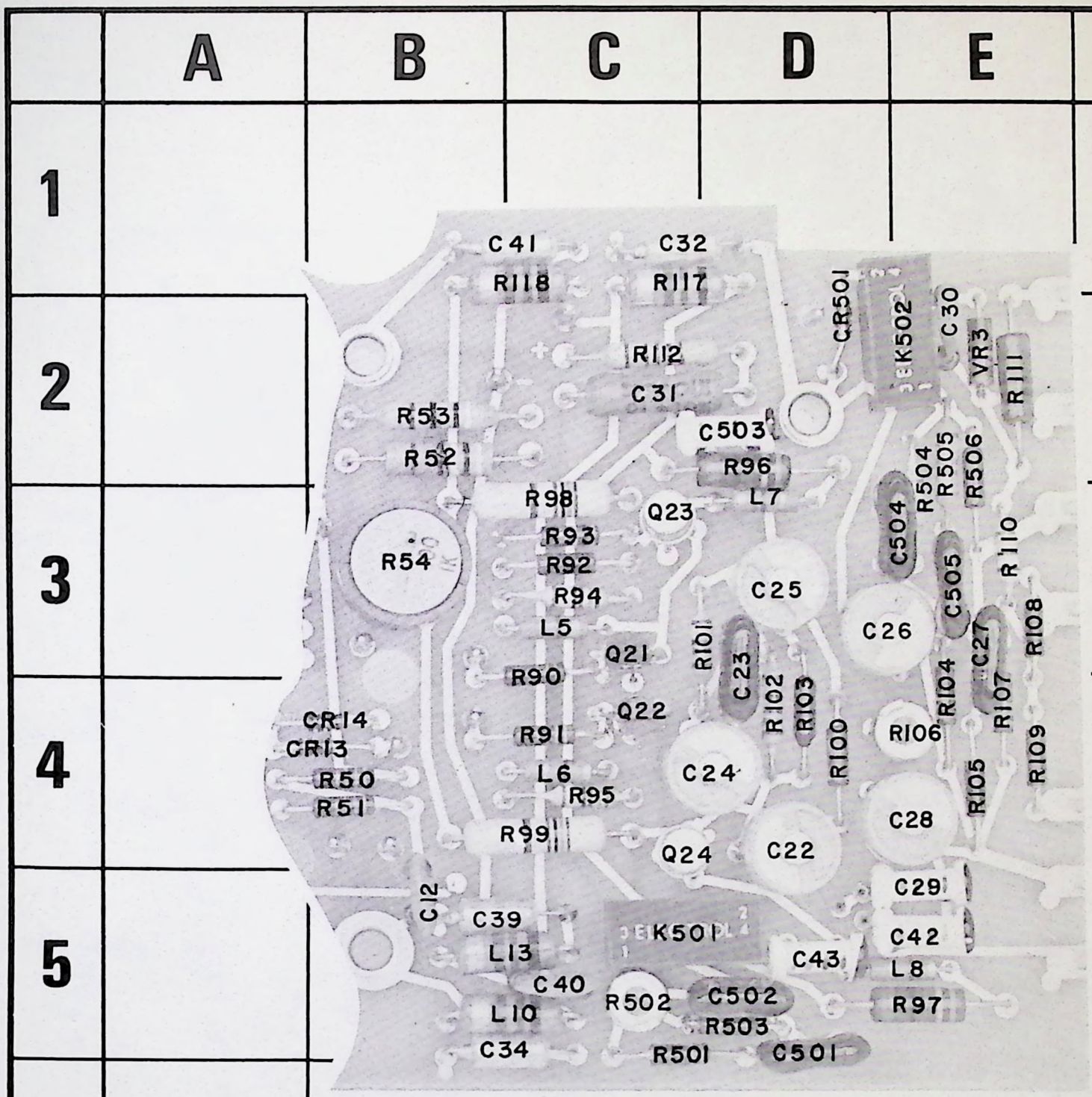
7-35. The replaceable parts list for the Model 1801A Option 001 is listed at the end of Table 6-2. Items listed with 500 series reference designators are components used in Option 001 only. Components listed with standard reference designators have new descriptions which are applicable to Option 001 only. The manufacturers' Code numbers and part numbers are available in Table 6-3 and 6-4.

Table 7-3. Replaceable Parts For A5

Reference Designation	HP Part No.	Description #	Note
A5	01801-66532	BOARD ASSY:SYNC AMPLIFIER	
A5C1	0160-2307	C:FXD MICA 47 PF 5% 300VDCW	
A5C2	0160-2307	C:FXD MICA 47 PF 5% 300VDCW	
A5C3	0150-0050	C:FXD CER DISC 1000 PF +80–20% 1000VDCW	
A5C4	0150-0050	C:FXD CER DISC 1000 PF +80–20% 1000VDCW	
A5C5	0160-2202	C:FXD MICA 75 PF 5% 300VDCW	
A5C6	0160-2264	C:FXD CER 20 PF 5% 500VDCW	
A5C7	0160-2145	C:FXD CER 5000 PF +80–20% 100VDCW	
A5C8	0150-0050	C:FXD CER DISC 1000 PF +80–20% 1000VDCW	
A5C9	0160-2145	C:FXD CER 5000 PF +80–20% 100VDCW	
A5C10	0180-0155	C:FXD ELECT 2.2 UF 20% 20VDCW	
A5C11	0180-0230	C:FXD ELECT 1.0 UF 20% 50VDCW	
A5C12	0150-0050	C:FXD CER DISC 1000 PF +80–20% 1000VDCW	
A5C13	0150-0050	C:FXD CER DISC 1000 PF +80–20% 1000VDCW	
A5C14	0180-0155	C:FXD ELECT 2.2 UF 20% 20VDCW	
A5C15	0180-0155	C:FXD ELECT 2.2 UF 20% 20VDCW	
A5CR1	5080-9614	DIODE: (MATCHED SET OF 4)	
A5CR2		N.S.R. PART OF A5CR1	
A5CR3		N.S.R. PART OF A5CR1	
A5CR4		N.S.R. PART OF A5CR1	
A5CR5	1901-0040	DIODE:SILICON 30MA 30WV	
A5CR6	1901-0040	DIODE:SILICON 30MA 30WV	
A5CR7	1901-0040	DIODE:SILICON 30MA 30WV	
A5L1	9100-1631	COIL:CHOKE 56 UH 5%	
A5L2	9100-1631	COIL:CHOKE 56 UH 5%	
A5Q1	1853-0026	Q:SI PNP	
A5Q2	1854-0345	Q:SI NPN	
A5Q3	1853-0203	Q:SI PNP	
A5Q4	1854-0345	Q:SI NPN	
A5Q5	1854-0215	Q:SI NPN	
A5Q6	1853-0036	Q:SI PNP	
A5R1	0757-0407	R:FXD MET FLM 200 OHM 1% 1/8W	
A5R2	0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	
A5R3	0757-0805	R:FXD MET FLM 221 OHM 1% 1/2W	
A5R4		NOT ASSIGNED	
A5R5	0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	
A5R6	0757-0407	R:FXD MET FLM 200 OHM 1% 1/8W	
A5R7	0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	
A5R8	0757-0805	R:FXD MET FLM 221 OHM 1% 1/2W	
A5R9		NOT ASSIGNED	

Table 7-3. Replaceable Parts For A5 (Cont'd)

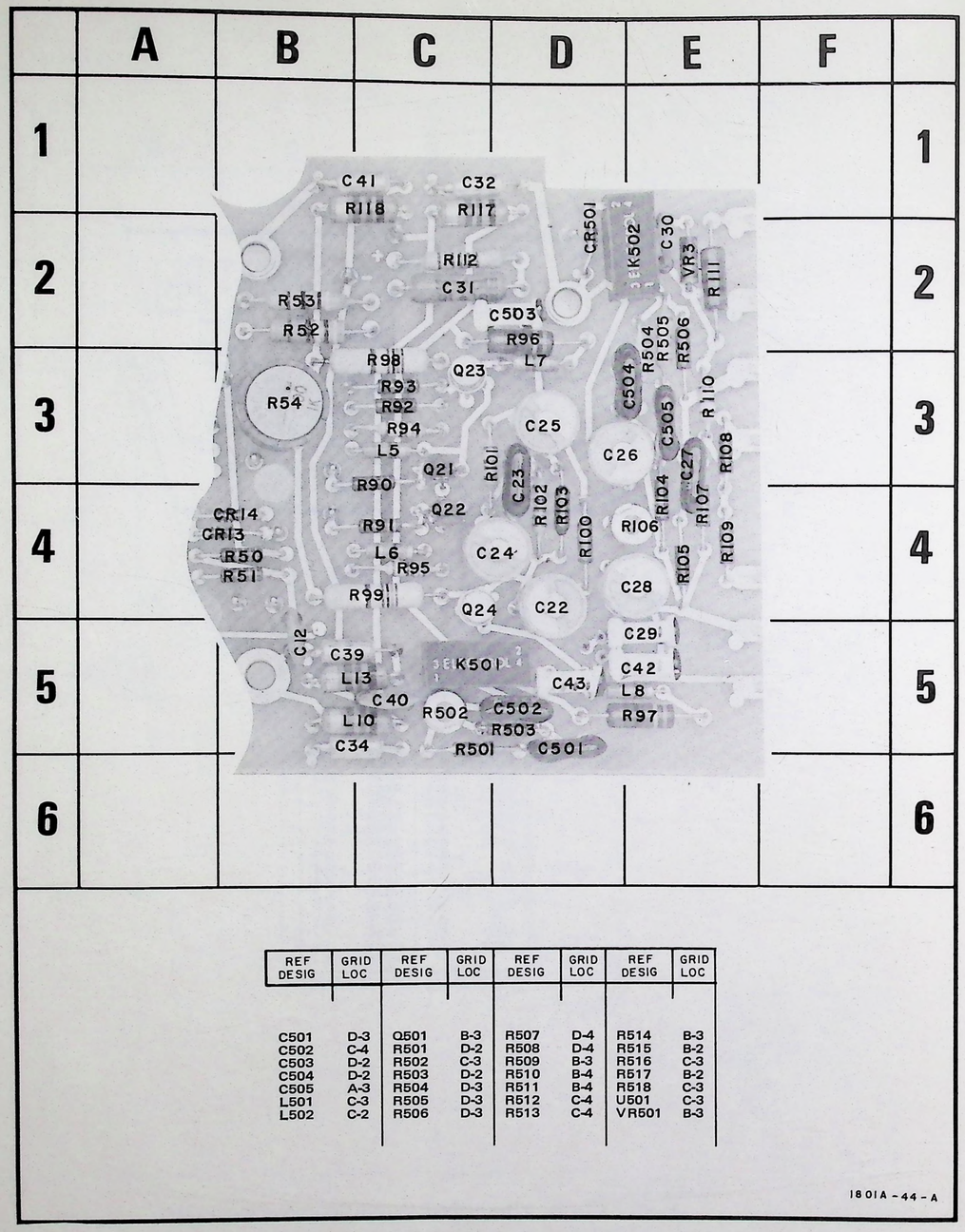
Reference Designation	HP Part No.	Description #	Note
A5R10	0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	
A5R11	0757-0715	R:FXD MET FLM 150 OHM 1% 1/4W	
A5R12	2100-1738	R:VAR FLM 10K OHM 10% LIN 1/2W	
A5R13	0757-0936	R:FXD FLM 3.3K OHM 2% 1/8W	
A5R14	0757-0398	R:FXD MET FLM 75 OHM 1% 1/8W	
A5R15	0757-0714	R:FXD FLM 130 OHM 1% 1/4W	
A5R16	0757-0284	R:FXD MET FLM 150 OHM 1% 1/8W	
A5R17	0757-0278	R:FXD MET FLM 1.78K OHM 1% 1/8W	
A5R18	0698-3446	R:FXD MET FLM 383 OHM 1% 1/8W	
A5R19	0757-0418	R:FXD MET FLM 619 OHM 1% 1/8W	
A5R20	0757-0422	R:FXD MET FLM 909 OHM 1% 1/8W	
A5R21	0757-0922	R:FXD FLM 820 OHM 2% 1/8W	
A5R22	0757-0276	R:FXD MET FLM 61.9 OHM 1% 1/8W	
A5R23	0757-0921	R:FXD MET FLM 750 OHM 2% 1/8W	
A5R24	0757-0418	R:FXD MET FLM 619 OHM 1% 1/8W	
A5R25	0757-0438	R:FXD MET FLM 5.11K 1% 1/8W	
A5R26	0757-0276	R:FXD MET FLM 61.9 OHM 1% 1/8W	
A5R27	0757-0416	R:FXD MET FLM 511 OHM 1% 1/8W	
A5R28	0698-3444	R:FXD MET FLM 316 OHM 1% 1/8W	
A5R29	0757-0935	R:FXD FLM 3K OHM 2% 1/8W	
A5R30	0757-0728	R:FXD MET FLM 619 OHM 1% 1/4W	
A5R31	0698-3200	R:FXD FLM 8K OHM 1% 1/8W	
A5R32	0757-0907	R:FXD FLM 200 OHM 2% 1/8W	
A5R33	0757-0907	R:FXD FLM 200 OHM 2% 1/8W	
A5R34	0757-0907	R:FXD FLM 200 OHM 2% 1/8W	
A5R35	0757-0415	R:FXD MET FLM 475 OHM 1% 1/8W	
A5R36	0757-0422	R:FXD MET FLM 909 OHM 1% 1/8W	
A5TP1	0360-0124	TERMINAL:SOLDER LUG	
A5U1	1820-0352	INTEGRATED CIRCUIT:DIGITAL	
A5VR1	1902-0041	DIODE:BREAKDOWN 5.11V 5%	
A5VR2	1902-0041	DIODE:BREAKDOWN 5.11V 5%	



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C501	D-3	Q501	B-3	R507	D-4	R514	B-3
C502	C-4	R501	D-2	R508	D-4	R515	B-2
C503	D-2	R502	C-3	R509	B-3	R516	C-3
C504	D-2	R503	D-2	R510	B-4	R517	B-2
C505	A-3	R504	D-3	R511	B-4	R518	C-3
L501	C-3	R505	D-3	R512	C-4	U501	C-3
L502	C-2	R506	D-3	R513	C-4	VR501	B-3

1801A-44-A

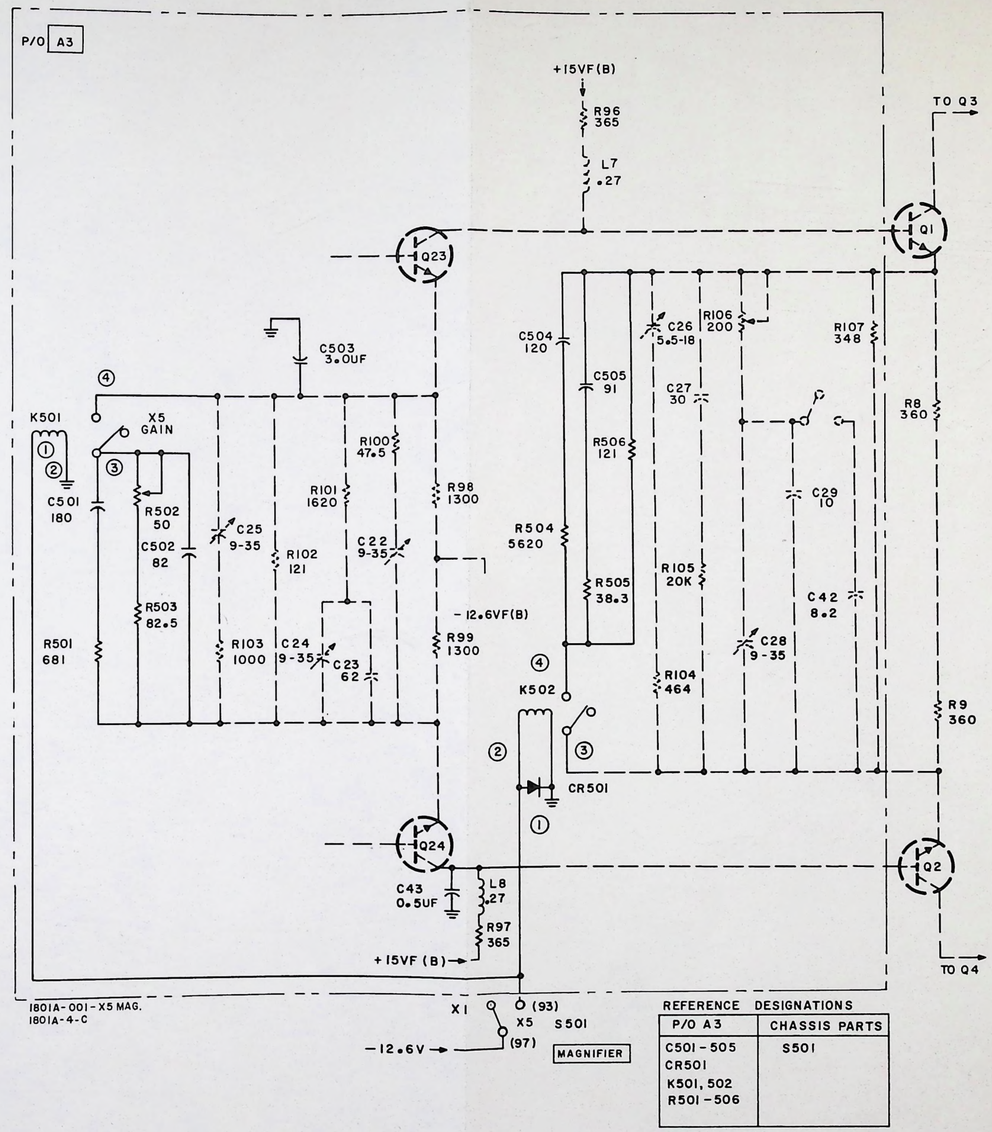
Figure 7-1. Option 001, X5 Magnification, Component Identification



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C501	D-3	Q501	B-3	R507	D-4	R514	B-3
C502	C-4	R501	D-2	R508	D-4	R515	B-2
C503	D-2	R502	C-3	R509	B-3	R516	C-3
C504	D-2	R503	D-2	R510	B-4	R517	B-2
C505	A-3	R504	D-3	R511	B-4	R518	C-3
L501	C-3	R505	D-3	R512	C-4	U501	C-3
L502	C-2	R506	D-3	R513	C-4	VR501	B-3

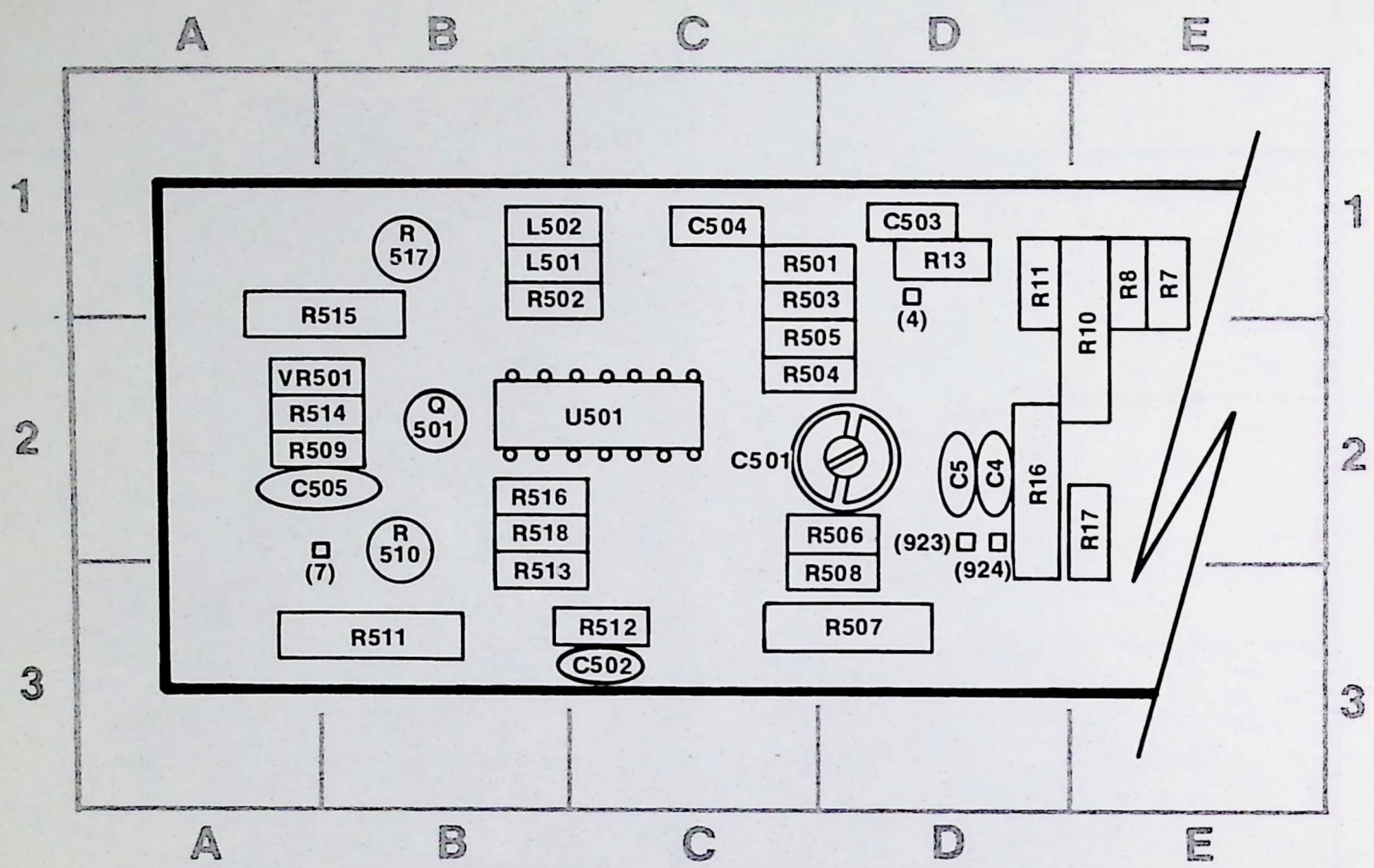
1801A-44-A

Figure 7-1. Option 001, X5 Magnification, Component Identification



REFERENCE DESIGNATIONS	
P/O A3	CHASSIS PARTS
C501-505 CR501 K501, 502 R501-506	S501

Figure 7-2.
Option 001, X5 Magnification Schematic



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C4	D-2	R502	B-1
C5	D-2	R503	C-1
C501	C-2	R504	C-2
C502	C-3	R505	C-2
C503	D-1	R506	D-2
C504	C-1	R507	D-3
C505	B-2	R508	D-2
L501	B-1	R509	A-2
L502	B-1	R510	B-2
Q501	B-2	R511	B-3
R7	E-1	R512	C-3
R8	E-1	R513	B-3
R10	E-2	R514	A-2
R11	D-1	R515	A-2
R13	D-1	R516	B-2
R16	D-2	R517	B-1
R17	E-2	R518	B-2
R501	C-1	U501	C-2
		VR501	A-2

Figure 7-3. Option 001, Channel B Output, Component Identification

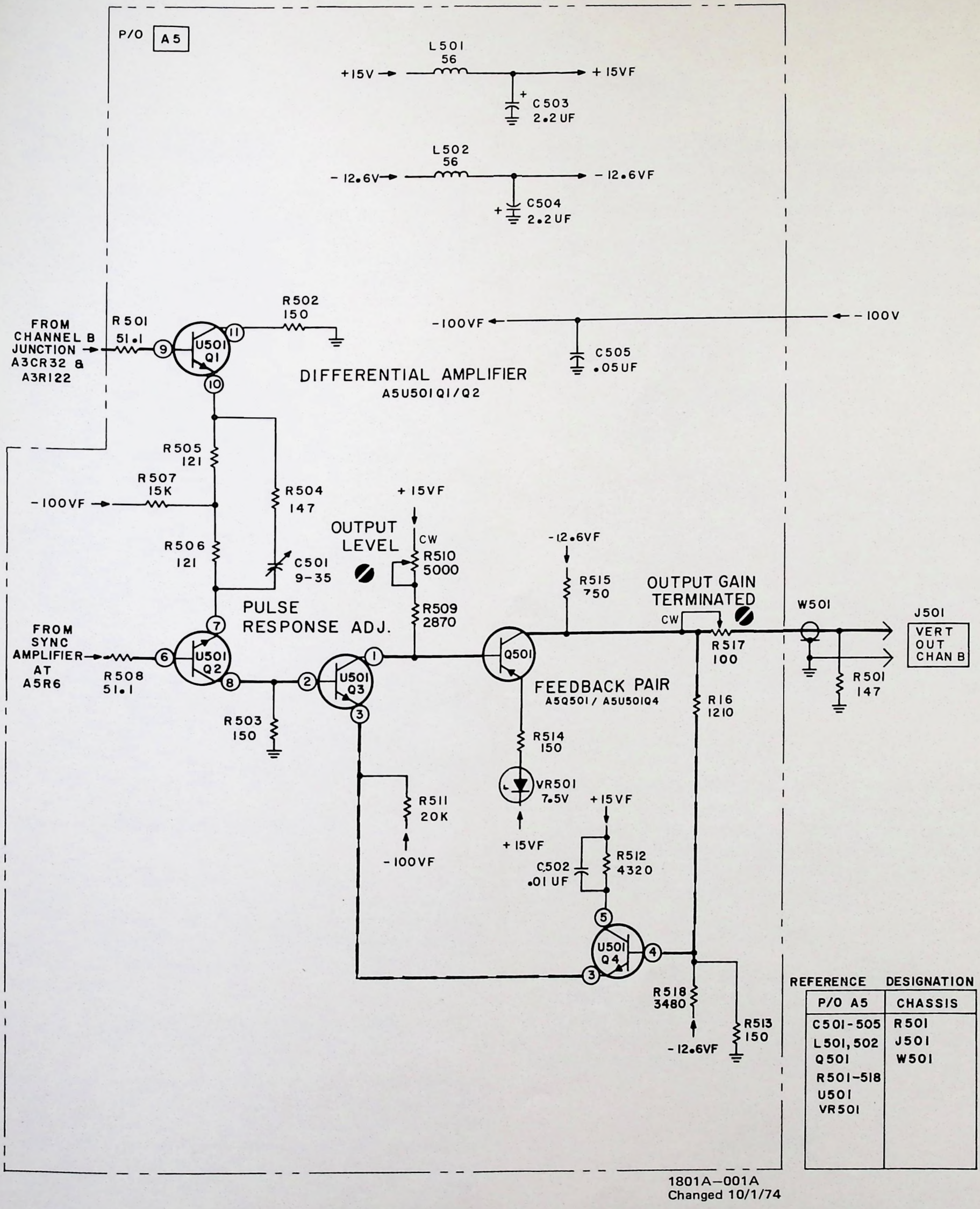


Figure 7-4. Option 001, Channel B Output Schematic

SECTION VIII

SCHEMATICS AND TROUBLESHOOTING

8-1. INTRODUCTION.

8-2. This section combines detailed information, including repair and replacement, component identification, and troubleshooting, all integrated with appropriate Schematic. Other information and procedures related to performance check and adjustment procedures are located in Section V.

8-3. SCHEMATICS.

8-4. All Schematics for the Model 1801A are contained in this section. (Refer to list of illustrations to locate a circuit by description). The Schematics are drawn to show electronic function of the circuitry. A given Schematic may include all or part of several different assemblies. Table 8-1 identifies the symbols and conventions used. The Schematics also indicate waveform testpoints and typical dc voltages; refer to troubleshooting paragraph for details of interpreting waveforms and dc voltages. All Schematics are printed so the entire Schematic unfolds outside the right-hand edge of the manual.

8-5. Each Schematic is identified by a number in the lower right-hand corner. The number will aid in locating points of interest. For example the multivibrator signal from the junction of A4R19 and A4C8 on Schematic 4 is referred to junction A3CR13 and A3CR15, Schematic 2. On Schematic 2 the multivibrator signal is referred back to A4R19, Schematic 4.

8-6. COMPONENT LOCATION.

8-7. Whenever possible, the location of components appearing on a Schematic is shown on the page opposite that Schematic. When components on an assembly appear on more than one Schematic, locations of all components on that assembly are identified opposite the first Schematic showing that assembly.

8-8. COMPONENT IDENTIFICATION.

8-9. All components within assembly border lines of Schematics are physically located on an etched circuit board or within a switch assembly. There are five assemblies listed in the replaceable parts list of this manual. To distinguish among different assemblies, each is designated on the Schematic with a letter A followed by a number between 1 and 5. Component designation begins with the number 1 for each type of component on each assembly and ascends in sequence (e. g. R1, R2, C1, C2,). Since component designation follows the same sequence on each assembly, designators are duplicated on different assemblies. Therefore, the complete description of resistor R1 on assembly A1 is A1R1, and resistor R1 on assembly A2 is A2R1. Components not physically located on an assembly are shown outside the assembly borders of the Schematics and have only the basic component designator, such as R1 or C1. These parts are listed after the assembly breakdown section of the parts list. A reference designation box on each Schematic indicates all Schematic component appearing on that Schematic.

8-10. TROUBLESHOOTING.

8-11. GENERAL.

8-12. Troubleshooting information in this manual applies directly to the Model 1801A. Refer to the appropriate manual for information on other instruments. The most important prerequisite to systematic troubleshooting is understanding instrument circuitry operation. Refer to Section IV for a block diagram and principles of operation. Use the basic operating procedures given in Section III to isolate a trouble to a circuit associated with a front-panel control. Also check for the proper outputs from the low and high voltage power supplies; these voltages affect the CRT display and proper operation of the plug-ins.

8-13. VISUAL INSPECTION.

8-14. Thoroughly inspect the instrument prior to using waveforms and dc voltages for troubleshooting. Check for burned or loose components, loose wire connections, faulty switch contacts, or any similar condition suggesting a source of the trouble. If the faulty operation is still present, proceed to the electrical checkout.

8-15. TROUBLESHOOTING TREE.

8-16. After observing symptoms of trouble, refer to the troubleshooting tree in Figure 8-1. The troubleshooting tree will help localize trouble to a definite area of the instrument. Use the text in conjunction with the troubleshooting tree to further localize the trouble.

CAUTION

When taking waveform or dc measurements, use extreme care to ensure that no supply voltages or components are shorted.

8-17. ELECTRICAL CHECKOUT.

8-18. Typical waveforms are located near the applicable Schematic. Always use specified conditions given with the waveforms for making waveform measurement. Check waveforms in a signal flow sequence; an incorrect waveform (or none) indicates the circuit likely to be at fault. Testpoints given on the Schematics are shown at an electrical point which is readily accessible at the physical/electrical corresponding point on the etched circuit board. Check typical dc voltages (given on the Schematic) in the suspect circuit to further isolate trouble to a specific component. Conditions for dc voltages are given opposite individual Schematics. Always allow time for a stable dc voltage level to be reached before noting the results. In locating test points on board assemblies, note that a small dot etched on the board identifies emitter lead of transistors, source lead of FET, cathode lead of diodes, and positive side of electrolytic capacitors.

8-19. REPAIR AND REPLACEMENT.

8-20. Most electrical components are accessible for replacement from component side of the etched circuit boards. Component identification is summerized in Paragraph 8-8. Section VI provides a detailed parts list for ordering replacement parts from Hewlett-Packard. Mechanical and miscellaneous electrical parts are listed in Table 6-2 by their respective reference designators and illustrated in Figure 6-1. If satisfactory operation or repair cannot be accomplished, contact the nearest Hewlett-Packard Sales/Service Office (addresses at rear of this manual). If shipment for repair is recommended, refer to Section II for recommended repackaging information.

8-21. SERVICING INTEGRATED CIRCUITS.

8-22. There are three integrated circuits used in the Model 1801A. All three require removal of specific leads when being replaced. Refer to Figure 8-2 for clipping the required leads for use in either Channel A or Channel B. Figure 8-17 shows the integrated circuit used in the sync amplifier circuit. When removing leads, be careful not to strain the leads. Use shear-type cutters to avoid damage to junctions inside the container.

8-23. If an integrated circuit is faulty and is not to be saved, clip the leads from the component, and refer to Paragraph 8-24 for servicing circuit boards.

8-24. SERVICING CIRCUIT BOARDS.

8-25. Etched circuit boards in this instrument have components mounted on one side of the board, conductive surfaces on both sides, and plated-through component mounting holes. Hewlett-Packard Service Note M-20E contains useful information on servicing etched circuit boards. Important considerations are:

a. Use low heat (37 to 47.5 watts, less than 850°F idling temperature), slightly bent chisel tip (1/16 to 1/8 inch diameter) soldering iron, and small diameter rosin core solder.

b. Remove components by placing soldering iron on component lead on either side of board, and pulling up on lead. If heat is applied to component side of board, use care to avoid damage to component (especially true for semiconductors). To prevent heat damage, grip lead with pair of pliers to provide heat sink between soldering iron and component.

c. If component is obviously damaged or faulty, clip leads close to component; then unsolder leads from board.

d. Large components such as potentiometers may be removed by rotating soldering iron from lead to lead; applying steady pressure to lift part free (alternative is to clip leads of damaged part).

e. Since conductor portion of etched circuit board is metal plated surface covered with solder, use care to avoid overheating which causes conductor to lift away from board. Lifted conductor may be cemented back in place with quick-drying acetate-base cement (use sparingly) having good insulating properties. Another method of repair is to solder section of good conducting wire along damaged area.

f. Clear solder from component hole before inserting new component lead. Avoid excessive heat on printed circuit board because damage to fiber board can occur. Heat solder in hole, remove iron, and quickly draw solder away using vacuum device, such as deluxe model Soldapullt manufactured by Edsyn Company of California.

g. Shape new component leads and clip to proper length. Insert leads into holes, apply heat, and solder (preferably on side opposite component).

Table 8-1. Schematic Notes

Refer to MIL-STD-15-1A for schematic symbols not listed in this table.

= Etched circuit board

= Front-panel marking

= Rear-panel marking

= Front-panel control

= Screwdriver adjustment

P/O = Part of

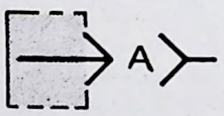
CW = Clockwise end of variable resistor

NC = No connection

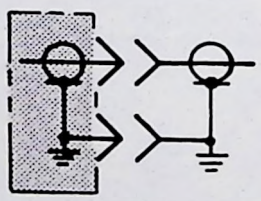
= Waveform test point (with number)

= Common electrical point (with letter) not necessarily ground

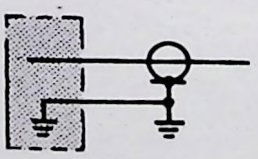
= Single-pin connector on board



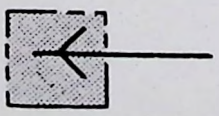
= Pin of a plug-in board (with letter or number)



= Coaxial cable connected to snap-on jack



= Coaxial cable connected directly to board



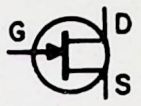
= Wire connected to pressure-fit socket on board

= Main signal path

= Primary feedback path

= Secondary feedback path

= Field-effect transistor (P-type base)

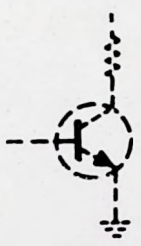


= Field-effect transistor (N-type base)

= Breakdown diode (voltage regulator)

= Tunnel diode

= Step-recovery diode

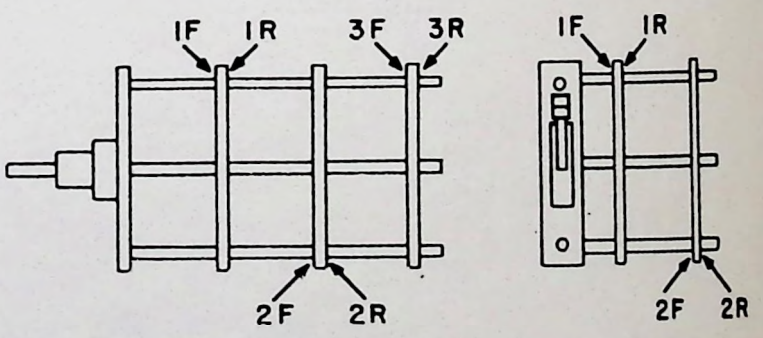


= Circuits or components drawn with dashed lines (phantom) show function only and are not intended to be complete. The circuit or component is shown in detail on another schematic.

(925) = Wire colors are given by numbers in parentheses using the resistor color code [(925) is wht-red-grn].

0 - Black	5 - Green
1 - Brown	6 - Blue
2 - Red	7 - Violet
3 - Orange	8 - Gray
4 - Yellow	9 - White

Switch wafers are identified as follows:



* = Optimum value selected at factory, typical value shown; part may have been omitted.

Unless otherwise indicated:
resistance in ohms
capacitance in picofarads
inductance in microhenries

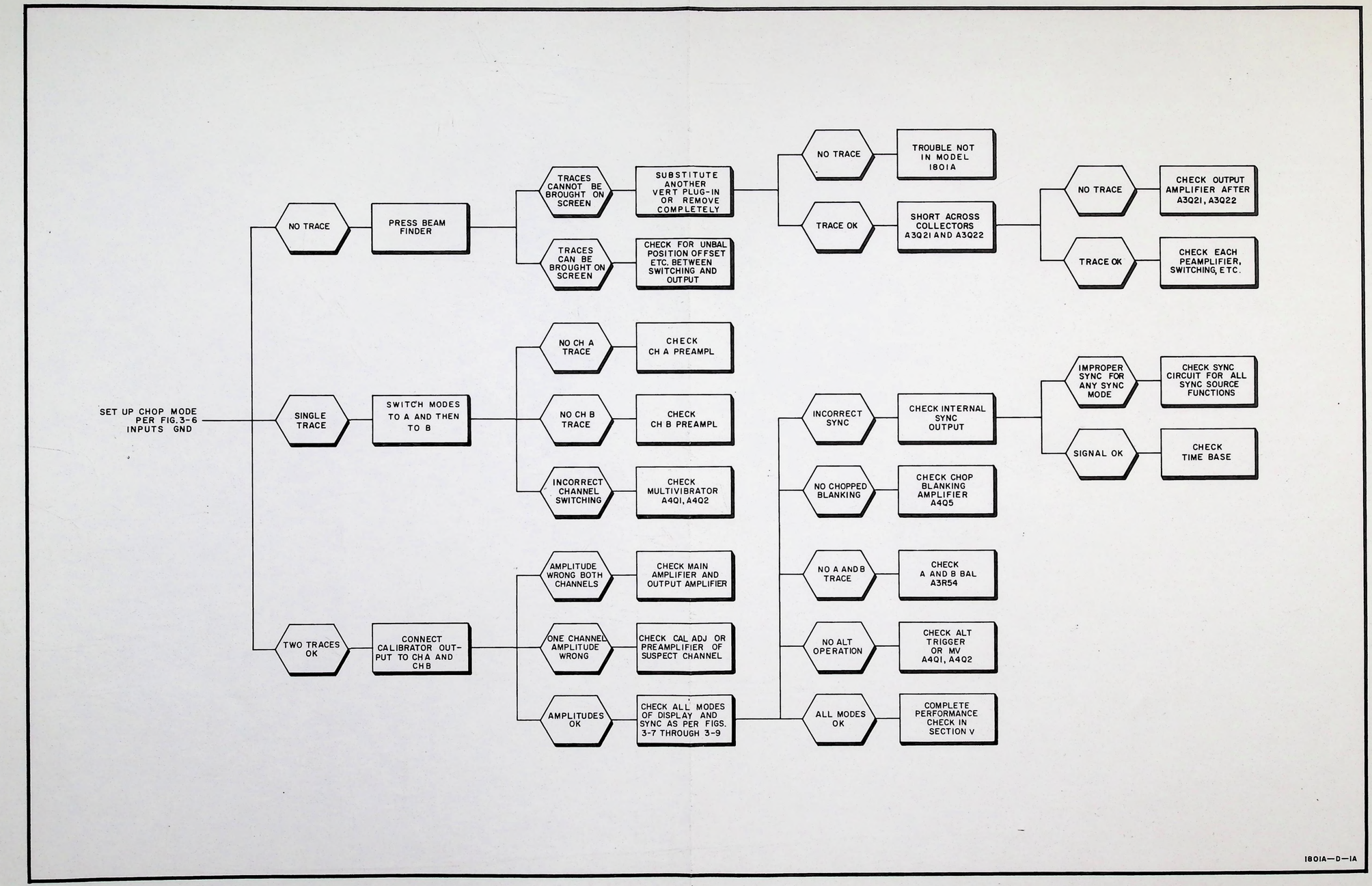
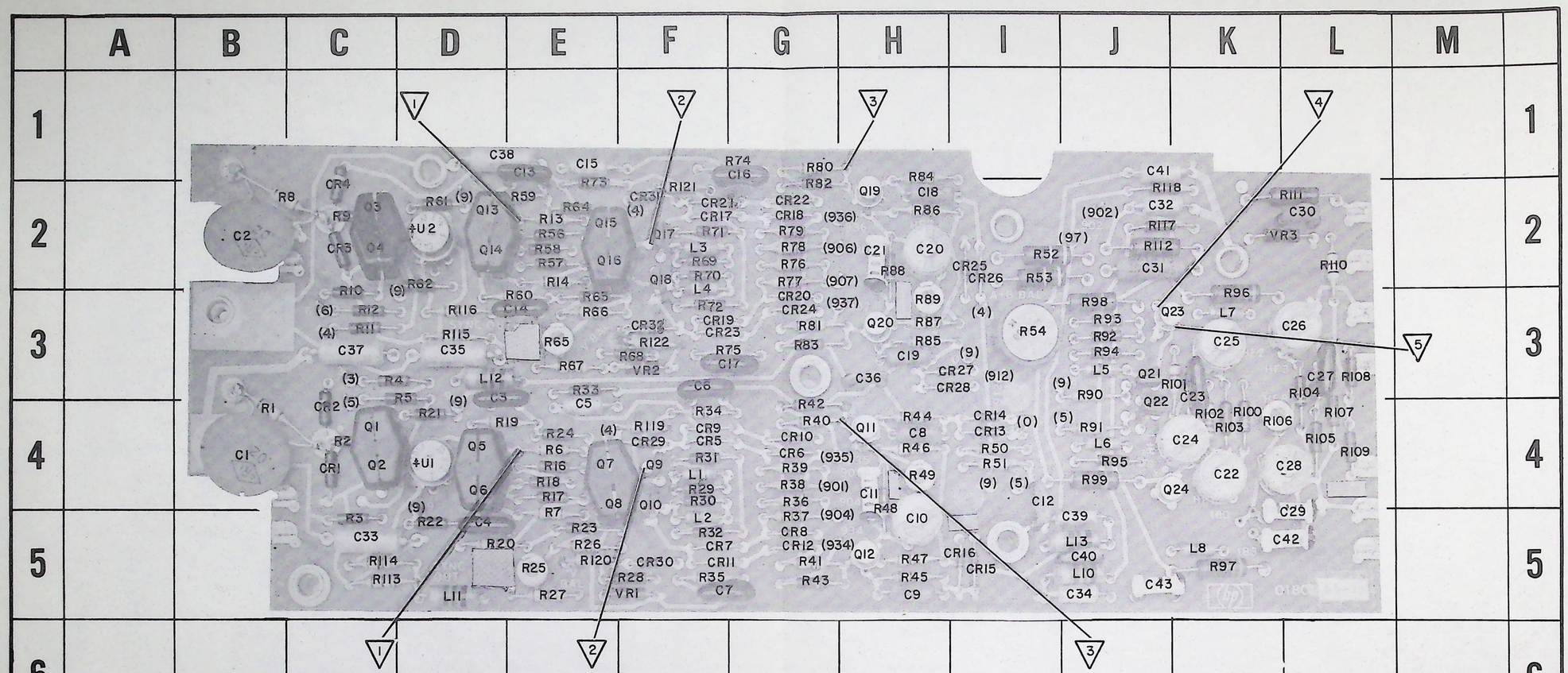
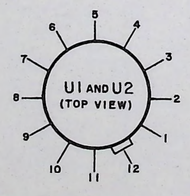


Figure 8-1.
Troubleshooting Tree



† Note: The two standard integrated circuits used in this assembly require the removal of leads 3, 4, 5, 9 and 11. Refer to Illustration for lead identification of U1 and U2. Refer to Paragraph 8-21 for suggested technique.



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-4	C21	H-2	C41	J-1	CR18	G-2	L7	K-3	Q15	E-2	R11	C-3	R31	F-4	R51	I-4	R71	F-2	R91	J-4	R111	L-2
C2	B-2	C22	K-4	C42	K-5	CR19	F-3	L8	K-5	Q16	E-2	R12	C-3	R32	F-5	R52	I-2	R72	F-3	R92	J-3	R112	J-2
C3	D-3	C23	K-3	C43	J-5	CR20	G-3	L10	J-5	Q17	F-2	R13	E-2	R33	E-3	R53	I-2	R73	E-2	R93	J-3	R113	C-5
C4	D-5	C24	K-4	CR1	C-4	CR21	F-2	L11	D-5	Q18	F-2	R14	E-2	R34	F-4	R54	I-3	R74	G-1	R94	J-3	R114	C-5
C5	E-4	C25	K-3	CR2	C-4	CR22	G-2	L12	D-3	Q19	H-2	R16	E-4	R35	F-5	R56	E-2	R75	F-3	R95	J-4	R115	D-3
C6	F-3	C26	L-3	CR3	C-2	CR23	F-3	L13	J-5	Q20	H-3	R17	E-4	R36	G-4	R57	E-2	R76	G-2	R96	K-3	R116	D-3
C7	F-5	C27	L-3	CR4	C-2	CR24	G-3	Q1	C-4	Q21	J-3	R18	E-4	R37	G-5	R58	E-2	R77	G-2	R97	K-5	R117	J-2
C8	H-4	C28	K-4	CR5	F-4	CR25	I-2	Q2	C-4	Q22	J-4	R19	D-4	R38	G-4	R59	E-2	R78	G-2	R98	J-3	R118	J-2
C9	H-5	C29	L-5	CR6	G-4	CR26	I-2	Q3	C-2	Q23	J-3	R20	D-5	R39	G-4	R60	E-3	R79	G-2	R99	J-4	R119	F-4
C10	H-5	C30	L-2	CR7	F-5	CR27	H-3	Q4	C-2	Q24	J-4	R21	D-4	R40	G-4	R61	D-2	R80	G-2	R100	K-4	R120	E-5
C11	H-4	C31	J-2	CR8	G-5	CR28	H-3	Q5	D-4	R1	B-4	R22	D-5	R41	G-5	R62	D-2	R81	G-3	R101	J-3	R121	F-2
C12	I-4	C32	J-2	CR9	F-4	CR29	F-4	Q6	D-4	R2	C-4	R23	E-5	R42	G-4	R63	E-3	R82	G-2	R102	K-4	R122	F-3
C13	E-1	C33	C-5	CR10	G-4	CR30	F-5	Q7	E-4	R3	C-5	R24	E-4	R43	G-5	R64	E-2	R83	G-3	R103	K-4	U1	D-4
C14	E-3	C34	J-5	CR11	F-5	CR31	F-2	Q8	E-4	R4	C-3	R25	E-5	R44	H-4	R65	E-3	R84	H-1	R104	L-3	U2	D-2
C15	E-1	C35	D-3	CR12	G-5	CR32	F-3	Q9	F-4	R5	D-3	R26	E-5	R45	H-5	R66	E-3	R85	H-3	R105	L-4	VR1	F-5
C16	G-1	C36	H-3	CR13	I-4	L1	F-4	Q10	F-4	R6	E-4	R27	E-5	R46	H-4	R67	E-3	R86	H-2	R106	K-4	VR2	F-3
C17	F-3	C37	C-3	CR14	I-4	L2	F-5	Q11	H-4	R7	E-5	R28	F-5	R47	H-5	R68	F-3	R87	H-3	R107	L-4	VR3	K-2
C18	H-2	C38	D-1	CR15	I-5	L4	F-2	Q12	H-5	R8	C-2	R29	F-4	R48	H-4	R69	F-2	R88	H-2	R108	L-3		
C19	H-3	C39	J-5	CR16	I-5	L5	F-2	Q13	D-2	R9	C-2	R30	F-4	R49	H-4	R70	F-2	R89	H-3	R109	L-4	1801A-B-14B (Changed 10-74)	
C20	H-2	C40	J-5	CR17	F-2	L6	J-3	Q14	D-2	R10	C-2			R50	I-4			R90	J-3	R110	L-2		

Figure 8-2. Component Location for A3

Figure

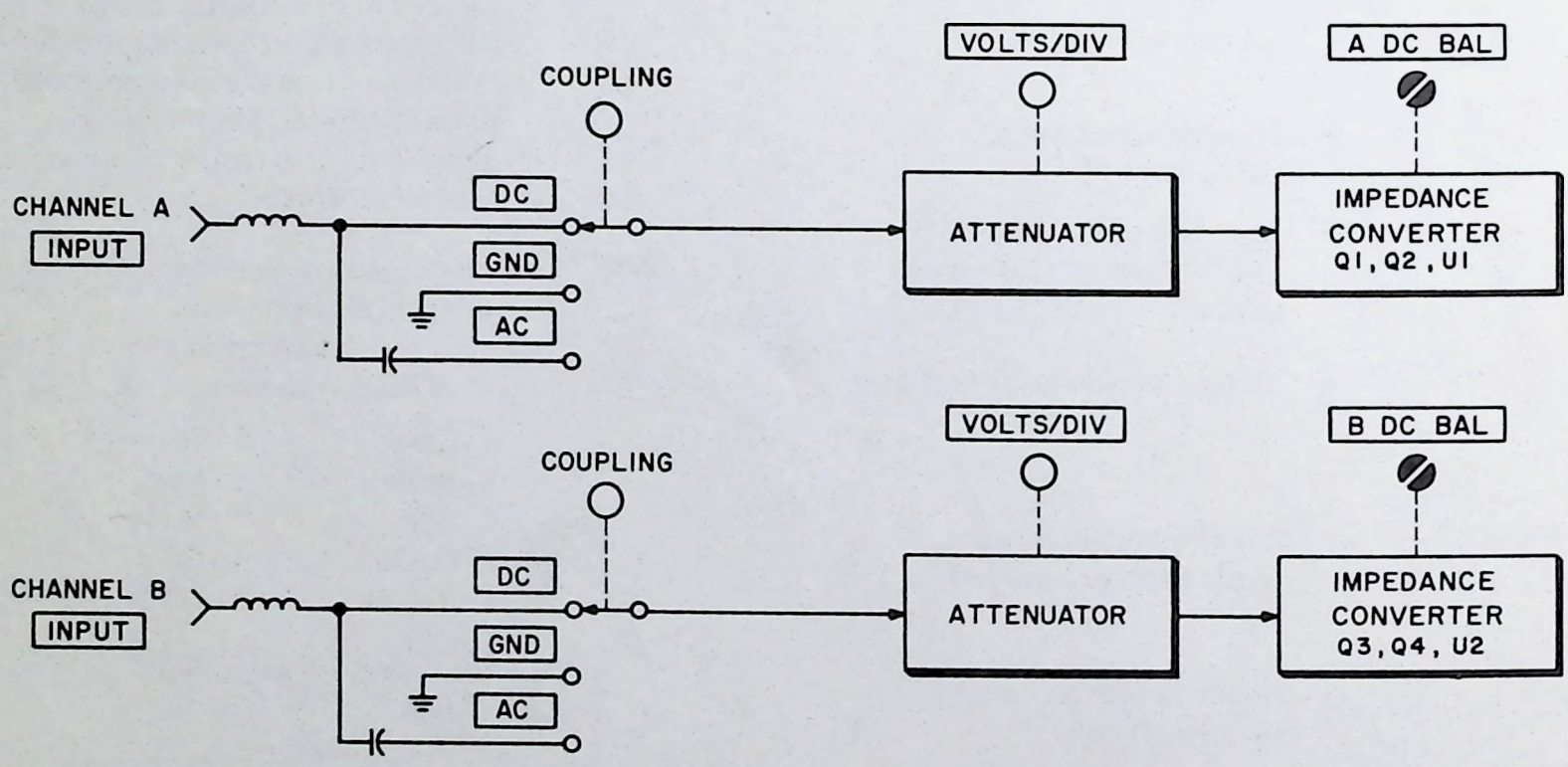
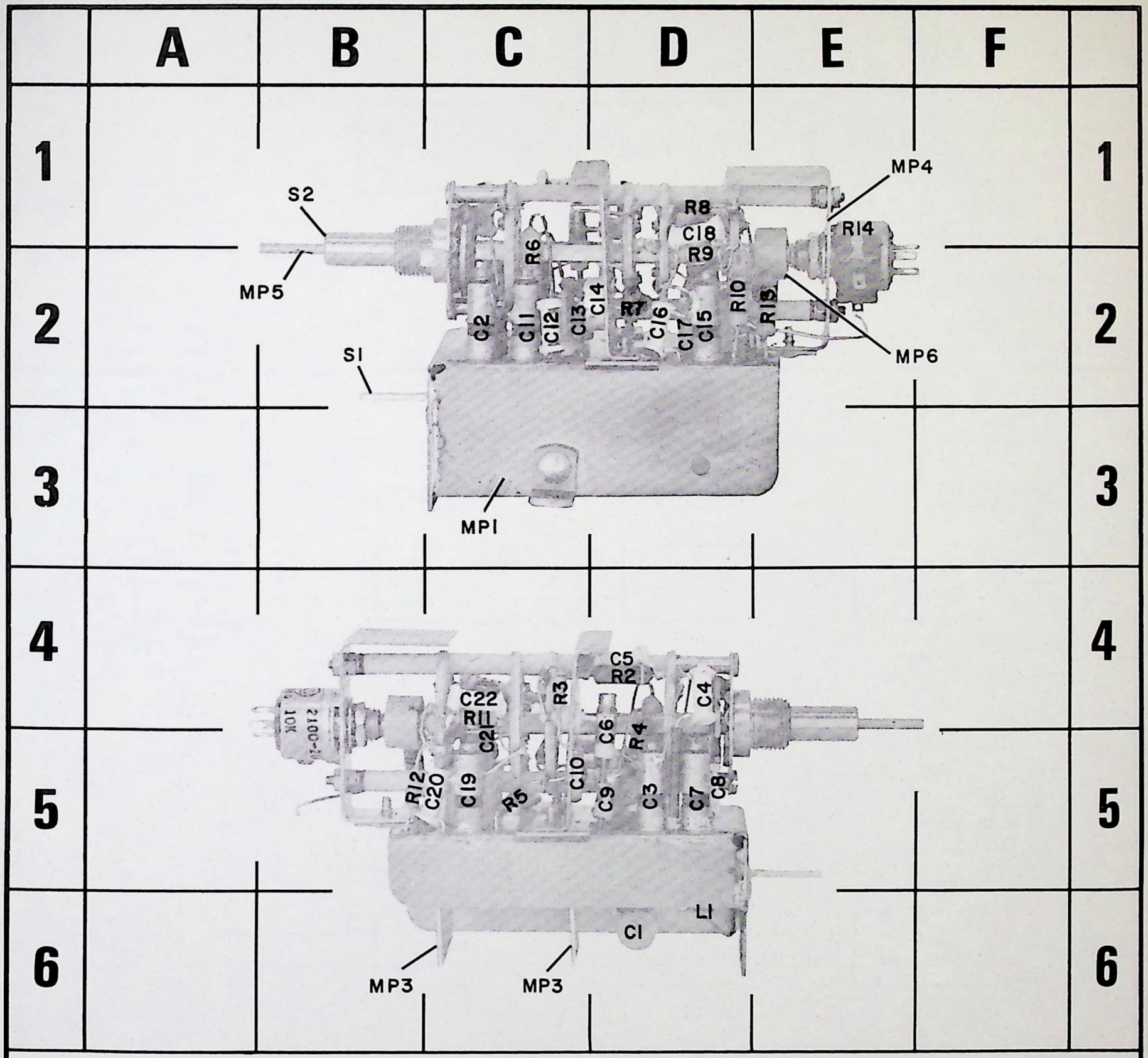


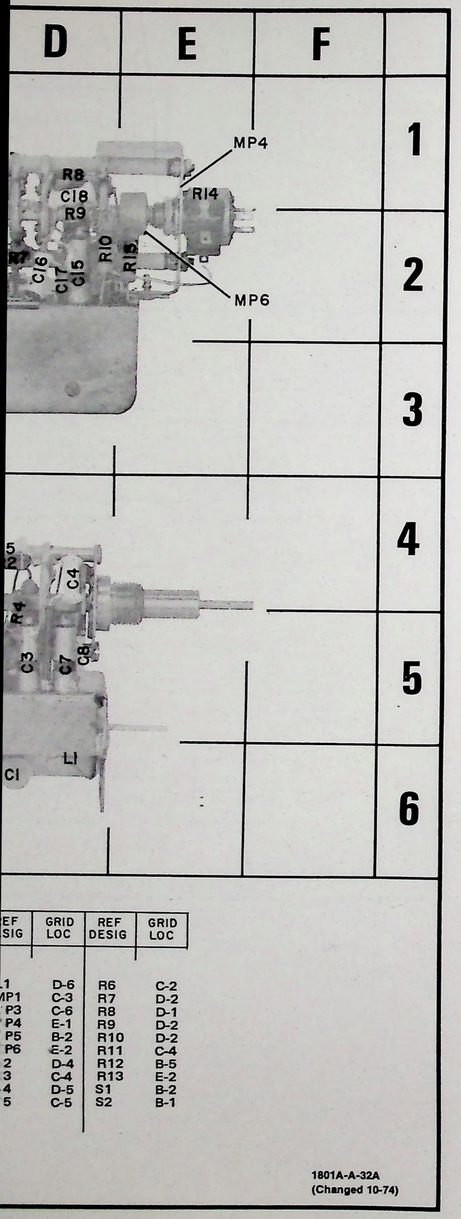
Figure 8-3. Attenuators and Impedance Converters Block Diagram



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D-6	C12	C-2	L1	D-6	R6	C-2
C2	C-2	C13	C-2	MP1	C-3	R7	D-2
C3	D-5	C14	D-2	MP3	C-6	R8	D-1
C4	D-4	C15	D-2	MP4	E-1	R9	D-2
C5	D-4	C16	D-2	MP5	B-2	R10	D-2
C6	D-5	C17	D-2	MP6	E-2	R11	C-4
C7	D-5	C18	D-1	R2	D-4	R12	B-5
C8	D-5	C19	C-5	R3	C-4	R13	E-2
C9	D-5	C20	C-5	R4	D-5	S1	B-2
C10	C-5	C21	C-5	R5	C-5	S2	B-1
C11	C-2	C22	C-4				

1801A-A-32A
(Changed 10-74)

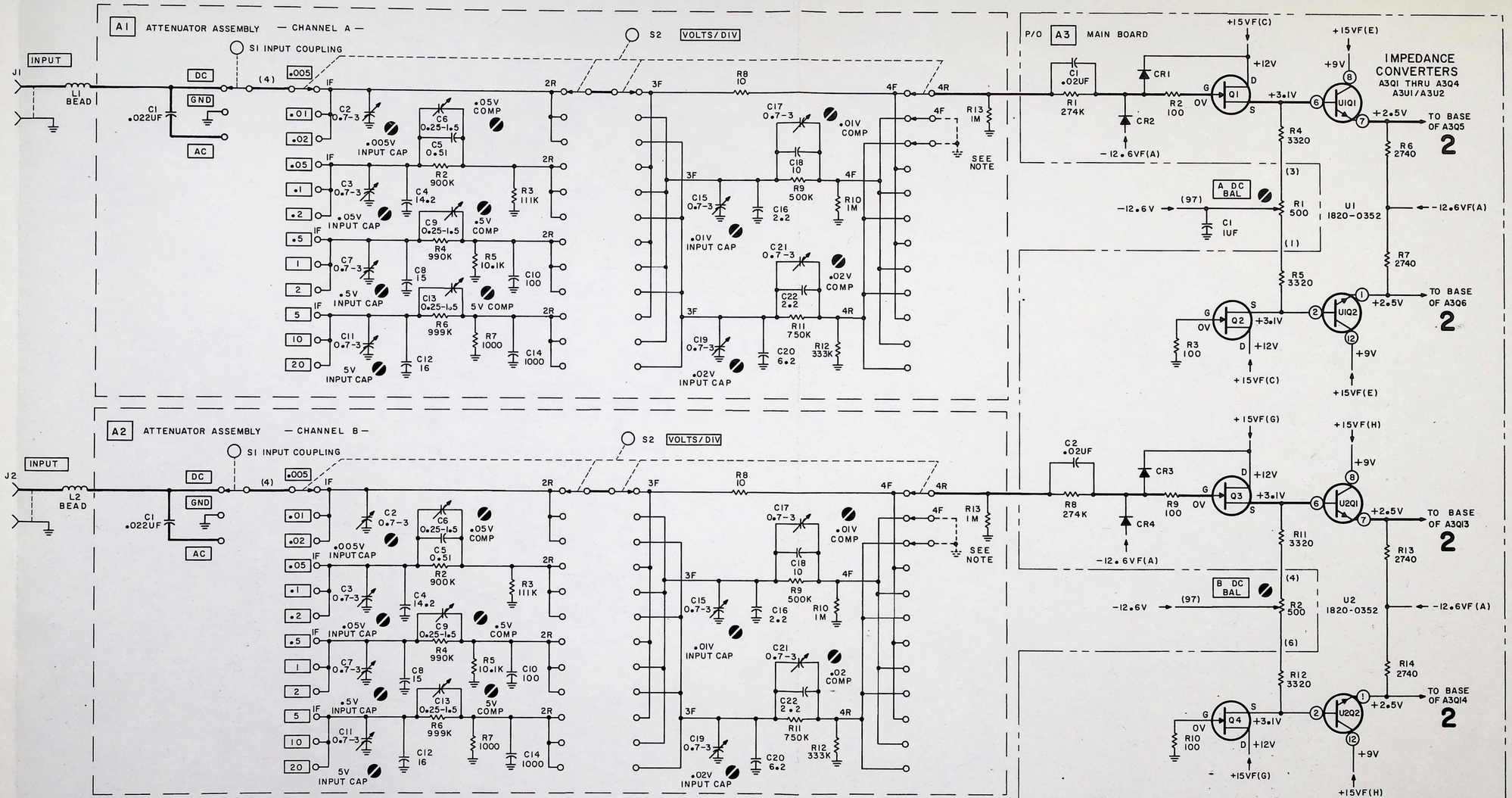
Figure 8-4. Component Identification for A1 and A2



REF DESIG	GRID LOC	REF DESIG	GRID LOC
L1	D-6	R6	C-2
MP1	C-3	R7	D-2
MP3	C-6	R8	D-1
MP4	E-1	R9	D-2
MP5	B-2	R10	D-2
MP6	E-2	R11	C-4
P2	D-4	R12	B-5
P3	C-4	R13	E-2
P4	D-5	S1	B-2
P5	C-5	S2	B-1

1801A-A-32A
(Changed 10-74)

ation for A1 and A2



1801A-ATTEN & INPUT IMPEDANCE CONV-951
(Changed 10-74)

NOTE:
WHEN ONE OF THE ATTENUATOR RANGES IS BEING USED THE OTHER TWO RANGES ARE GROUNDED.

REFERENCE DESIGNATIONS

A1	A2	P/O A3	CHASSIS PARTS
C1-22	C1-22	C1, 2	C1
R2-13	R1-13	CR1-4	J1,2
S1, 2	S1, 2	Q1-4	L1,2
		R1-14	R1,2
		U1, 2	

DELETED: A1R1

1

Figure 8-5.
Attenuators and Impedance Coverters Schematic
8-5

Component Location for A3 in Figure 8-2

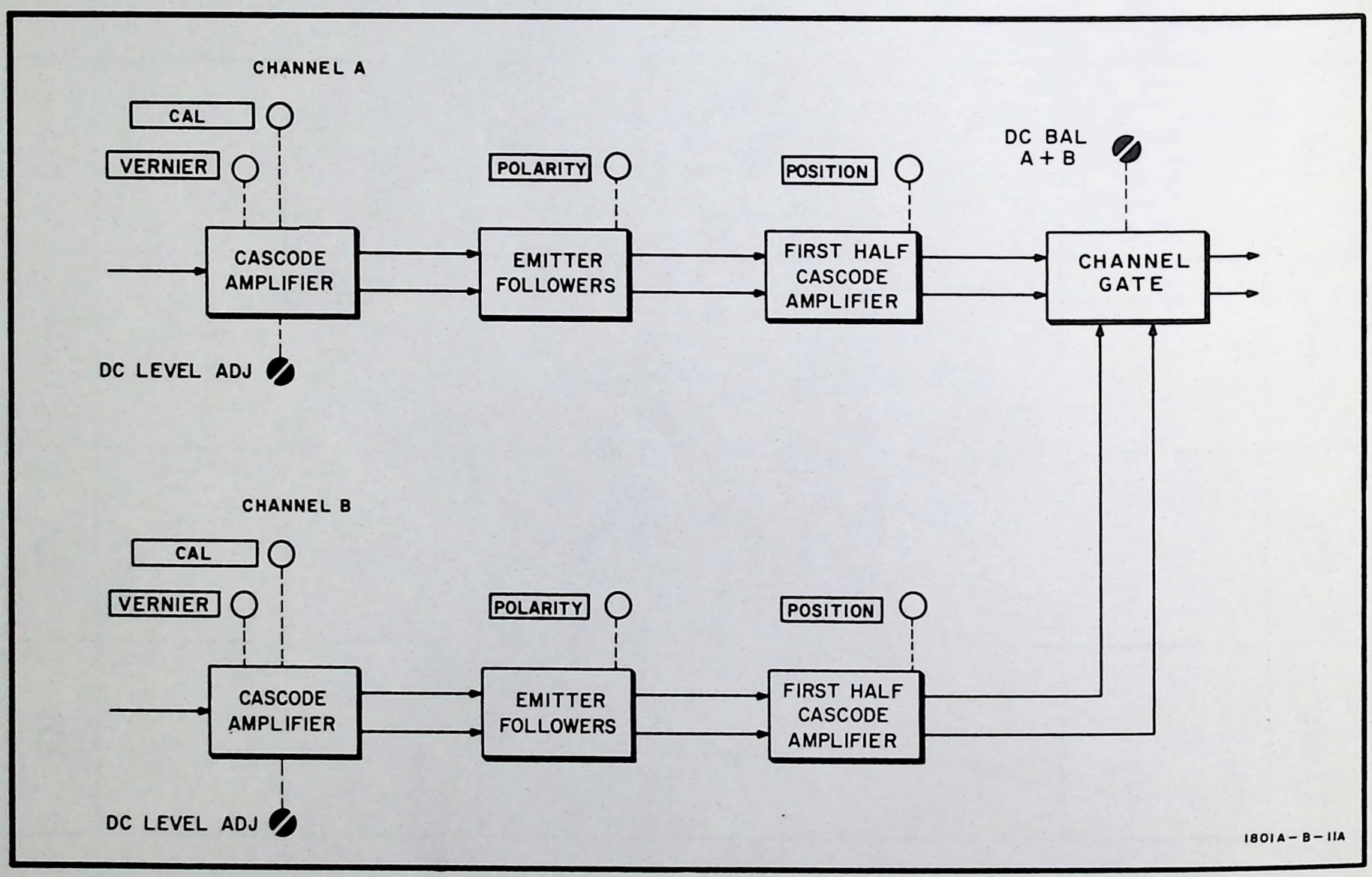


Figure 8-6. Input Amplifiers Block Diagram

DC VOLTAGE MEASUREMENT CONDITIONS

Control Settings:

Model 180A/AR

MAGNIFIER	X1
DISPLAY	INT

Model 1801A

DISPLAY	A
POLARITY, both channels	+UP
VOLTS/DIV, both channels	1
Vernier, both channels	CAL
Input coupling, both channels	GND
POSITION, A	center trace

WAVEFORM MEASUREMENT CONDITIONS

1. Control Settings:

Model 1801A

VOLTS/DIV, both channels	2
Vernier, both channels	CAL
POLARITY, both channels	+UP
DISPLAY	A
POSITION, both channels	center trace
Input coupling, both channels	AC

2. Connect Model 180A/AR CALIBRATOR 10V output (pk-pk, 1 kc) to the Model 1801A Channel A INPUT. To check Channel B operation, change DISPLAY to B and connect CALIBRATOR output to Channel B INPUT; same waveforms apply.

3. A 10:1 Voltage Divider Probe was used for all waveforms.

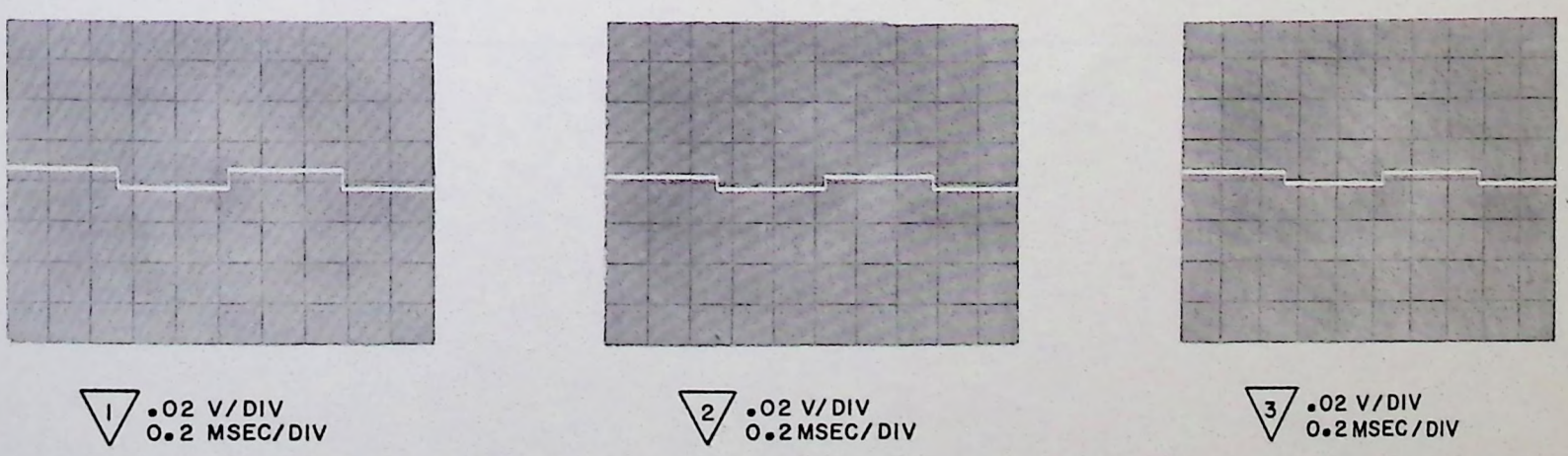


Figure 8-7. Input Amplifier Measurement Conditions and Waveforms

NT CONDITIONS

. . . . . X1
. . . . . INT

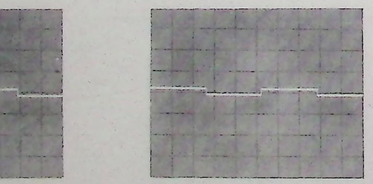
. . . . . A
. . . . . +UP
. 1
. . . . . CAL
. . . . . GND
. . . . . center trace

NT CONDITIONS

. 2
. . . . . CAL
. . . . . +UP
. . . . . A
. . . . . center trace
. . . . . AC

IBRATOR 10V output
Channel A INPUT. To
e DISPLAY to B and
o Channel B INPUT;

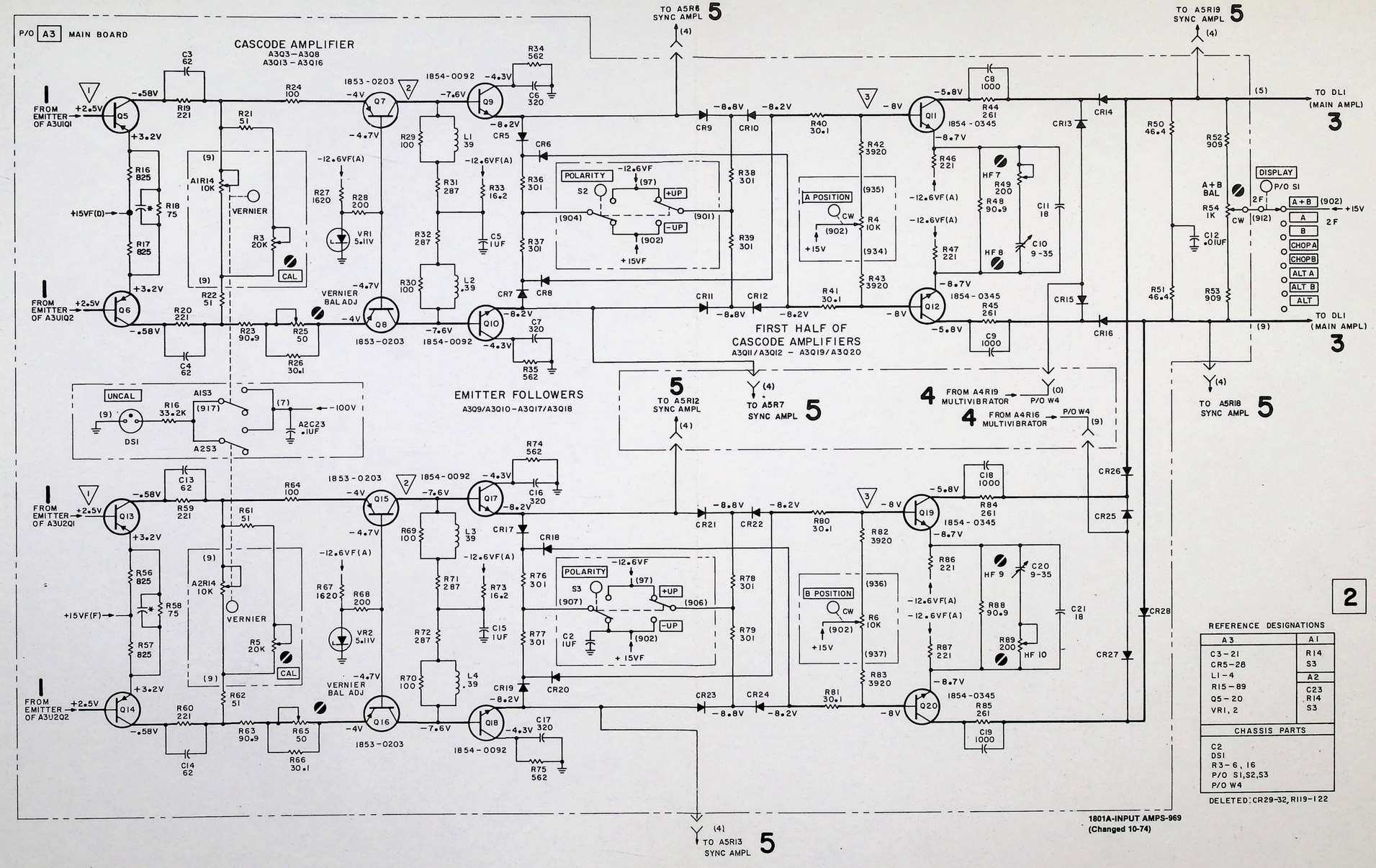
be was used for all



▽3 .02 V/DIV
0.2 MSEC/DIV

1801A-8-16

nt Conditions and Waveforms



REFERENCE DESIGNATIONS

A3	A1
C3-21	R14
CR5-28	S3
L1-4	A2
R15-89	C23
Q5-20	R14
VR1, 2	S3

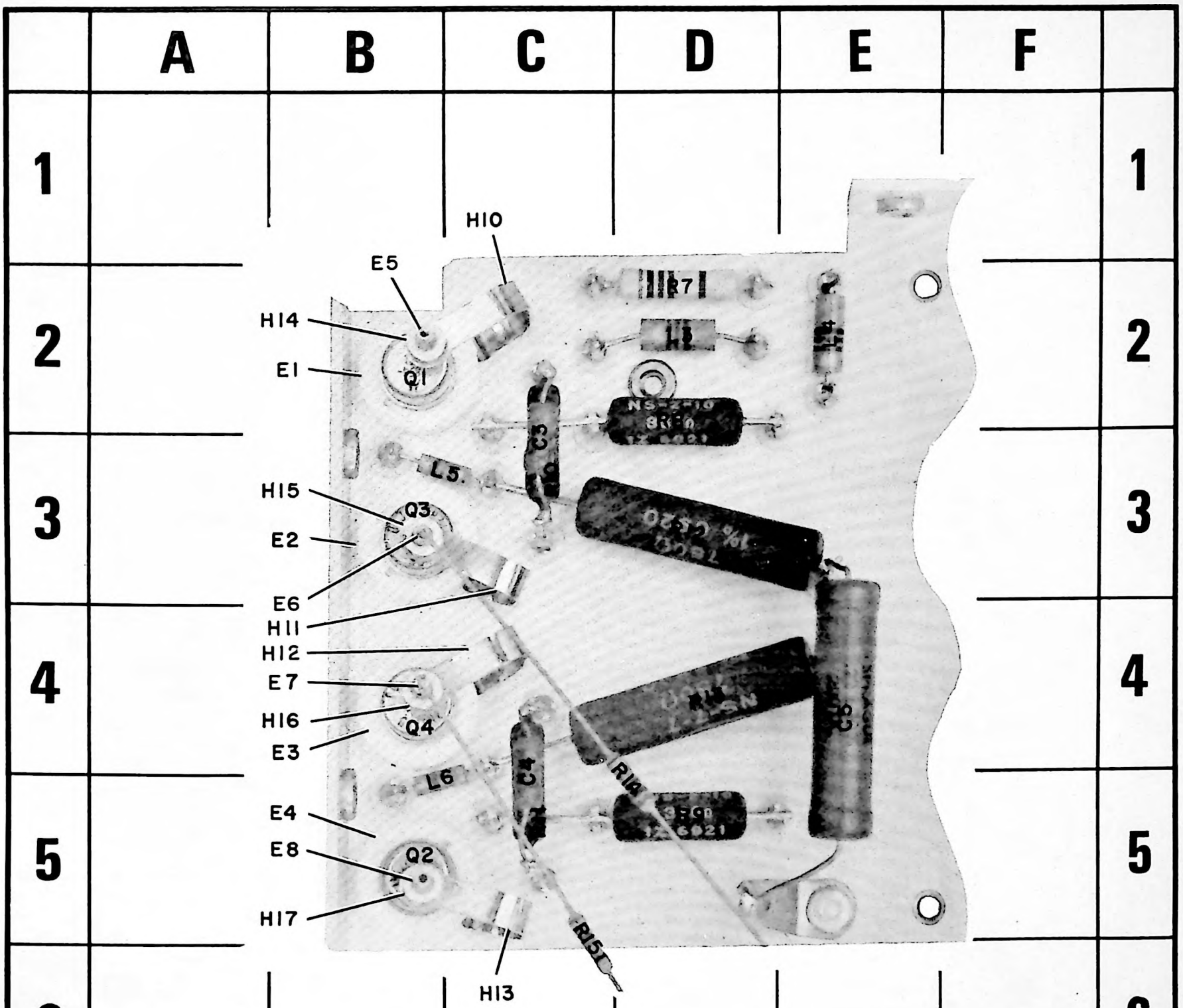
CHASSIS PARTS

C2
DS1
R3-6, 16
P/O S1,S2,S3
P/O W4

DELETED: CR29-32, R119-122

2

Figure 8-8.
Input Amplifier Schematic
8-7



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C3	C-3	E7	B-4	H17	B-5	R7	D-2
C4	C-4	E8	B-5	L1	D-2	R8	D-3
C5	E-4	H10	C-1	L2	E-2	R9	D-5
E1	B-2	H11	B-4	L3	C-3	R10	C-3
E2	B-3	H12	B-4	L4	B-5	R11	C-5
E3	B-4	H13	C-6	Q1	B-2	R12	C-3
E4	B-5	H14	B-2	Q2	B-5	R13	D-4
E5	B-2	H15	B-3	Q3	B-3	R16	D-5
E6	B-3	H16	B-4	Q4	B-4	R17	C-5

1801A-A-33A

Figure 8-9. Output Amplifier Component Location

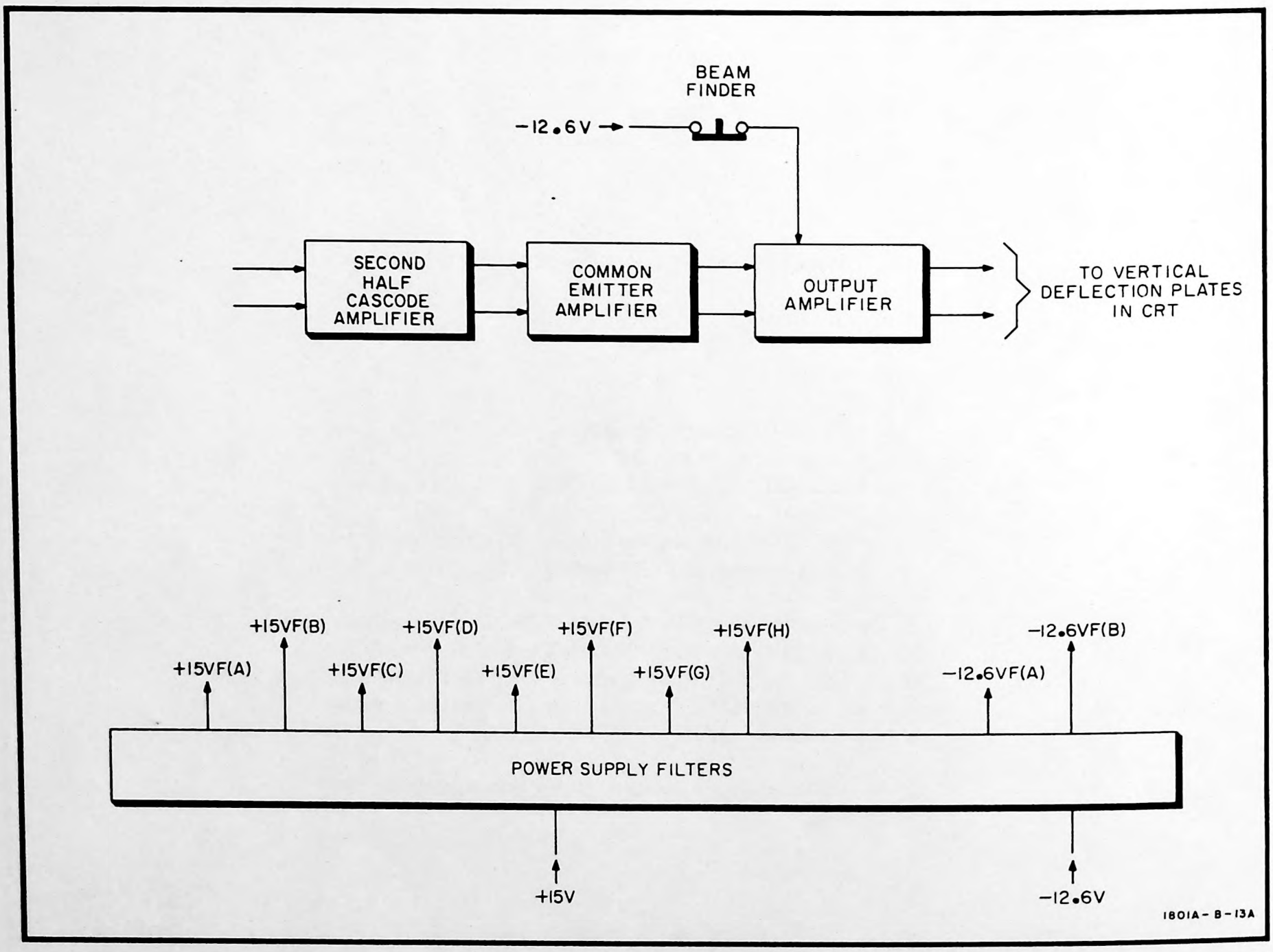


Figure 8-10. Main Amplifier Block Diagram

DC VOLTAGE MEASUREMENT CONDITIONS

Control Settings:

Model 180A/AR

MAGNIFIER X1
DISPLAY ..... INT

Model 1801A

DISPLAY ..... A
POLARITY, both channels ..... +UP
VOLTS/DIV, both channels 1
Vernier, both channels ..... CAL
Input coupling, both channels ..... GND
POSITION, A ..... center trace

WAVEFORM MEASUREMENT CONDITIONS

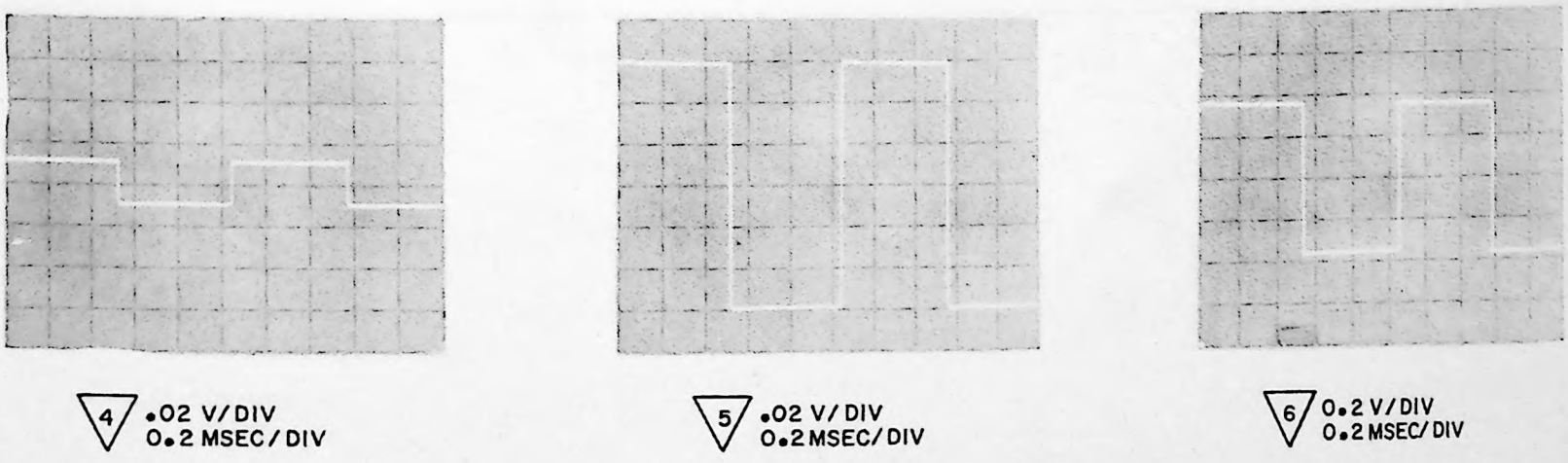
1. Control Settings:

Model 1801A

VOLTS/DIV, both channels 2
Vernier, both channels ..... CAL
POLARITY, both channels ..... +UP
DISPLAY ..... A
POSITION, both channels ..... center trace
Input coupling, both channels ..... AC

2. Connect Model 180A/AR CALIBRATOR 10V output (pk-pk, 1 kc) to the Model 1801A Channel A INPUT.

3. Using 10:1 Probe



1801A-B-17A
(Changed 10-74)

Figure 8-11. Main Amplifier Measurement Conditions and Waveforms

EMENT CONDITIONS

. . . . . X1
. . . . . INT

. . . . . A
els . . . . . +UP
nels 1
. . . . . CAL
nnels . . . . . GND
. . . . . center trace

EMENT CONDITIONS

nels 2
. . . . . CAL
els . . . . . +UP
. . . . . A
ls . . . . . center trace
nnels . . . . . AC

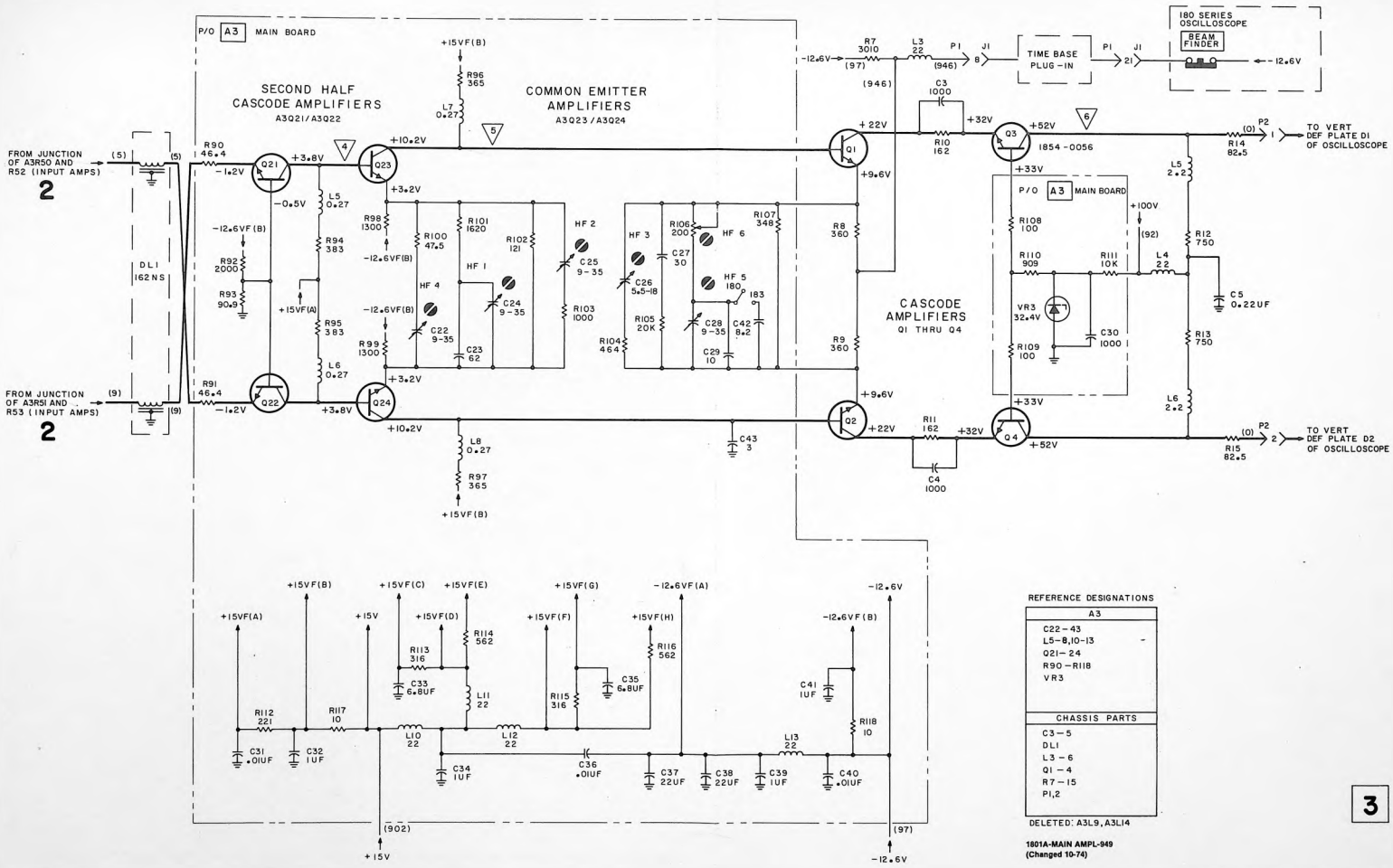
CALIBRATOR 10V output
01A Channel A INPUT.

V
/DIV

6 0.2 V/DIV
0.2 MSEC/DIV

1801A-B-17A
(Changed 10-74)

ement Conditions and Waveforms



REFERENCE DESIGNATIONS

A3
C22-43
L5-8,10-13
Q21-24
R90-R118
VR3

CHASSIS PARTS
C3-5
DL1
L3-6
Q1-4
R7-15
P1,2

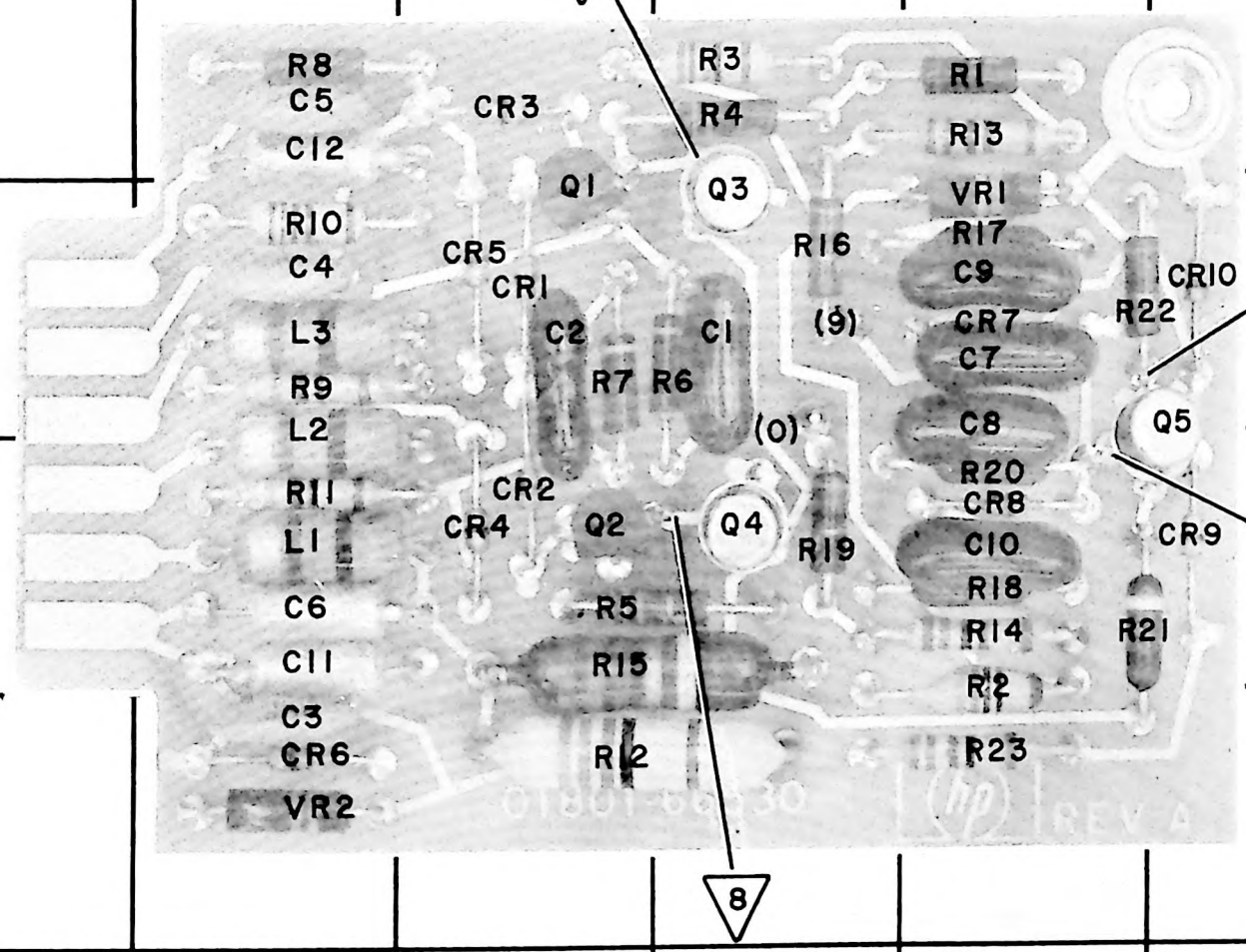
DELETED: A3L9, A3L14

1801A-MAIN AMPL-949
(Changed 10-74)

3

Figure 8-12.
Main Amplifier Schematic Diagram

	A	B	C	D	E	F	
1							1
2							2
3							3
4							4
5							5
6							6



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D-3	C8	E-3	CR3	C-2	CR10	F-3	Q4	D-4	R6	D-3	R13	E-2	R20	E-4
C2	C-3	C9	E-3	CR4	C-4	L1	B-4	Q5	F-3	R7	C-3	R14	E-4	R21	E-4
C3	B-5	C10	E-4	CR5	C-3	L2	B-3	R1	E-2	R8	B-2	R15	C-4	R22	E-3
C4	B-3	C11	B-4	CR6	B-5	L3	B-3	R2	E-4	R9	B-3	R16	D-3	R23	E-5
C5	B-2	C12	B-2	CR7	E-3	Q1	C-3	R3	D-2	R10	B-3	R17	E-3	VR1	E-3
C6	B-4	CR1	C-3	CR8	E-4	Q2	C-4	R4	D-2	R11	B-4	R18	E-4	VR2	B-5
C7	E-3	CR2	C-4	CR9	F-4	Q3	D-3	R5	C-4	R12	C-5	R19	D-4		

1801A-A-38A

Figure 8-13. Component Identification for A4

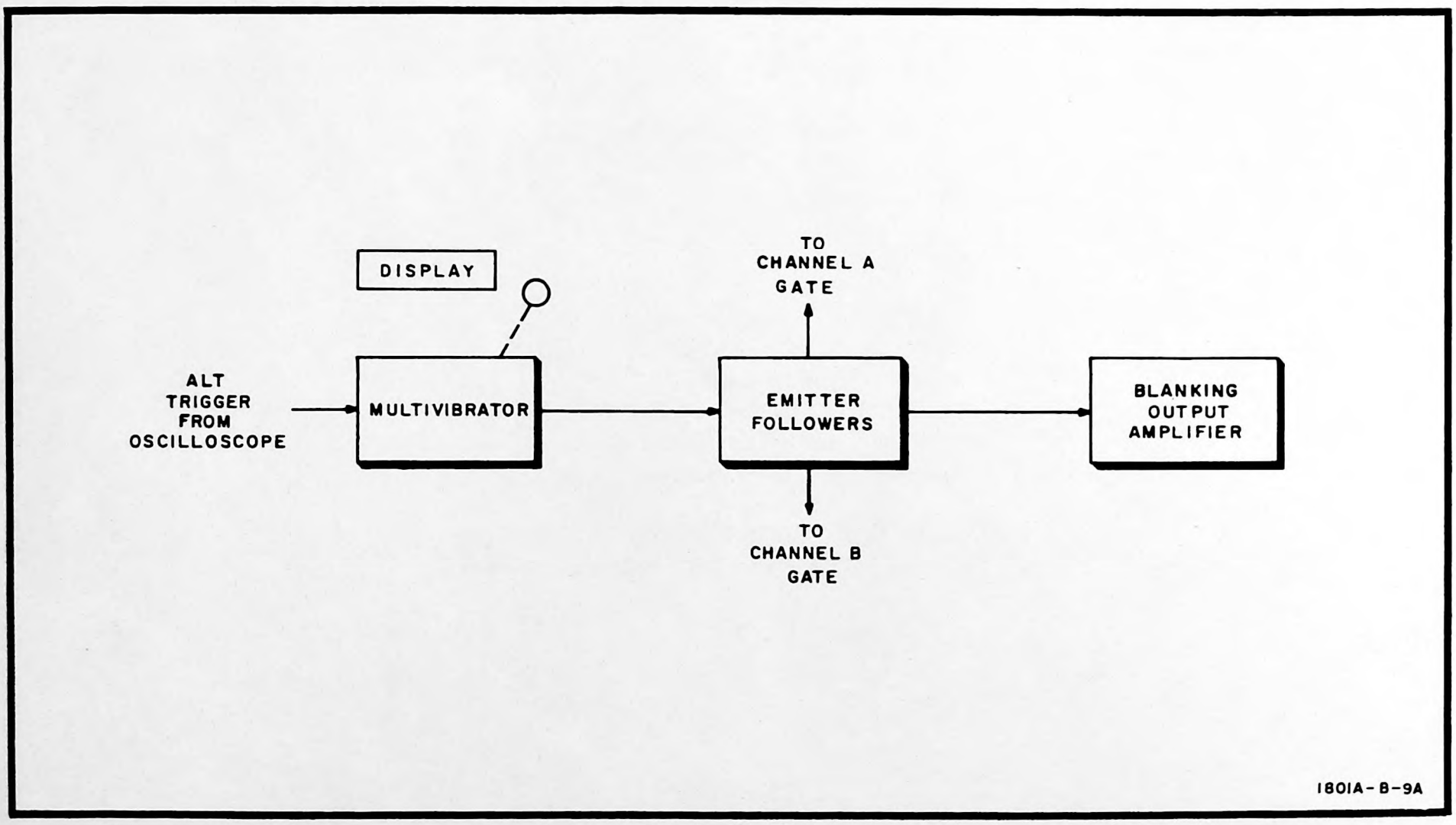


Figure 8-14. Multivibrator Block Diagram

DC VOLTAGE MEASUREMENT CONDITIONS

Control Settings:

Model 1801A

DISPLAY	A
POLARITY, both channels	+UP
VOLTS/DIV, both channels	1
Vernier, both channels	CAL
Input coupling, both channels	GND
POSITION, A	center trace

WAVEFORM MEASUREMENT CONDITIONS

1. Control Settings:

Model 1801A

DISPLAY	CHOP

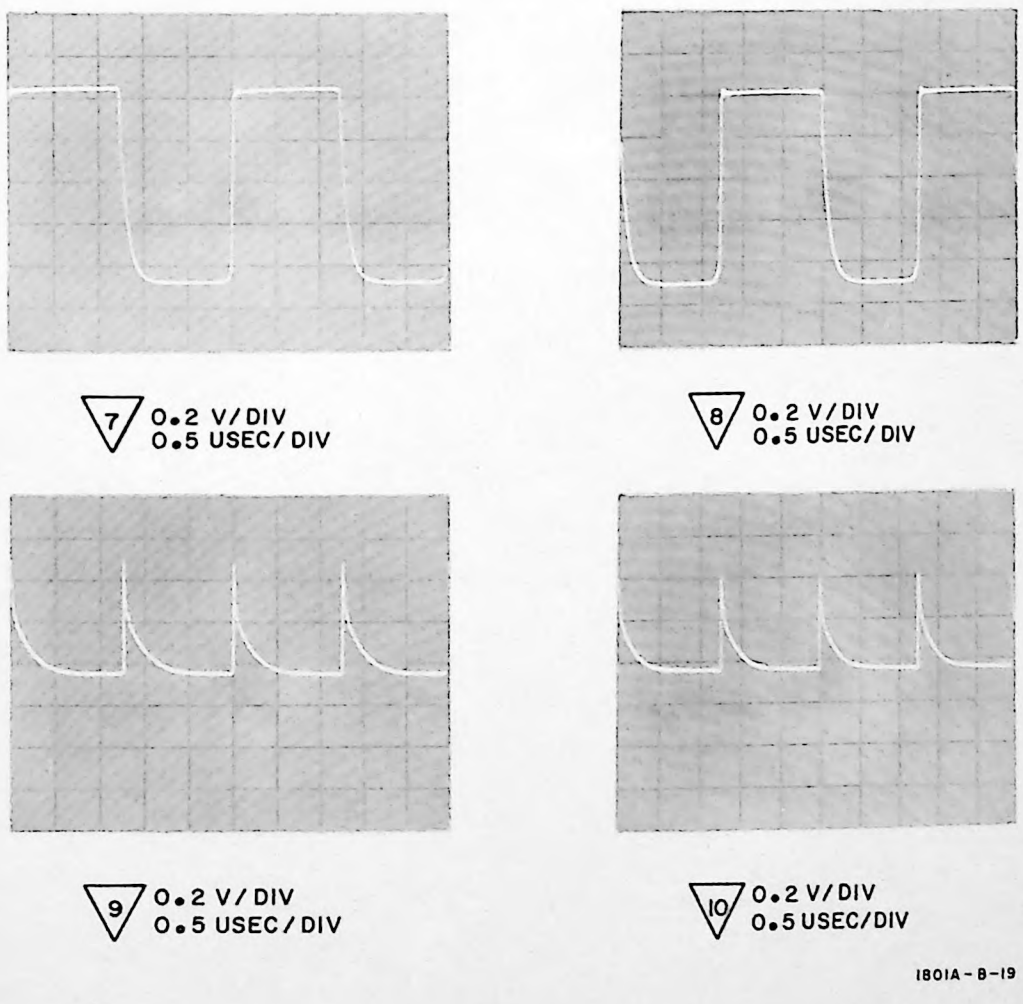


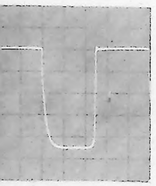
Figure 8-15. Multivibrator Measurement Conditions and Waveforms

'DITIONS

..... A
..... +UP
..... 1
..... CAL
..... GND
.. center trace

DITIONS

..... CHOP

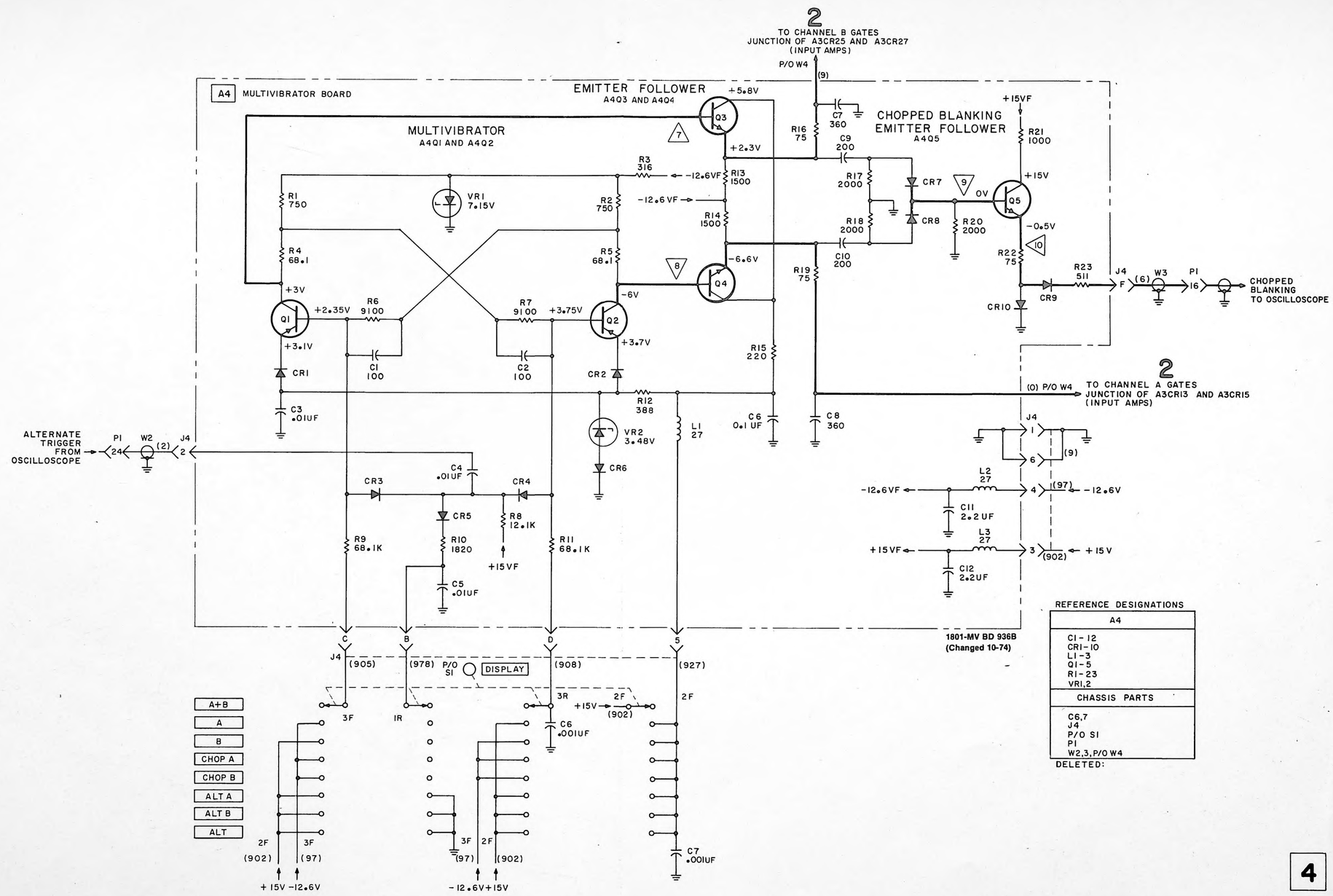


0.2 V/DIV
0.5 USEC/DIV

0.2 V/DIV
0.5 USEC/DIV

1801A-B-19

ons and Waveforms

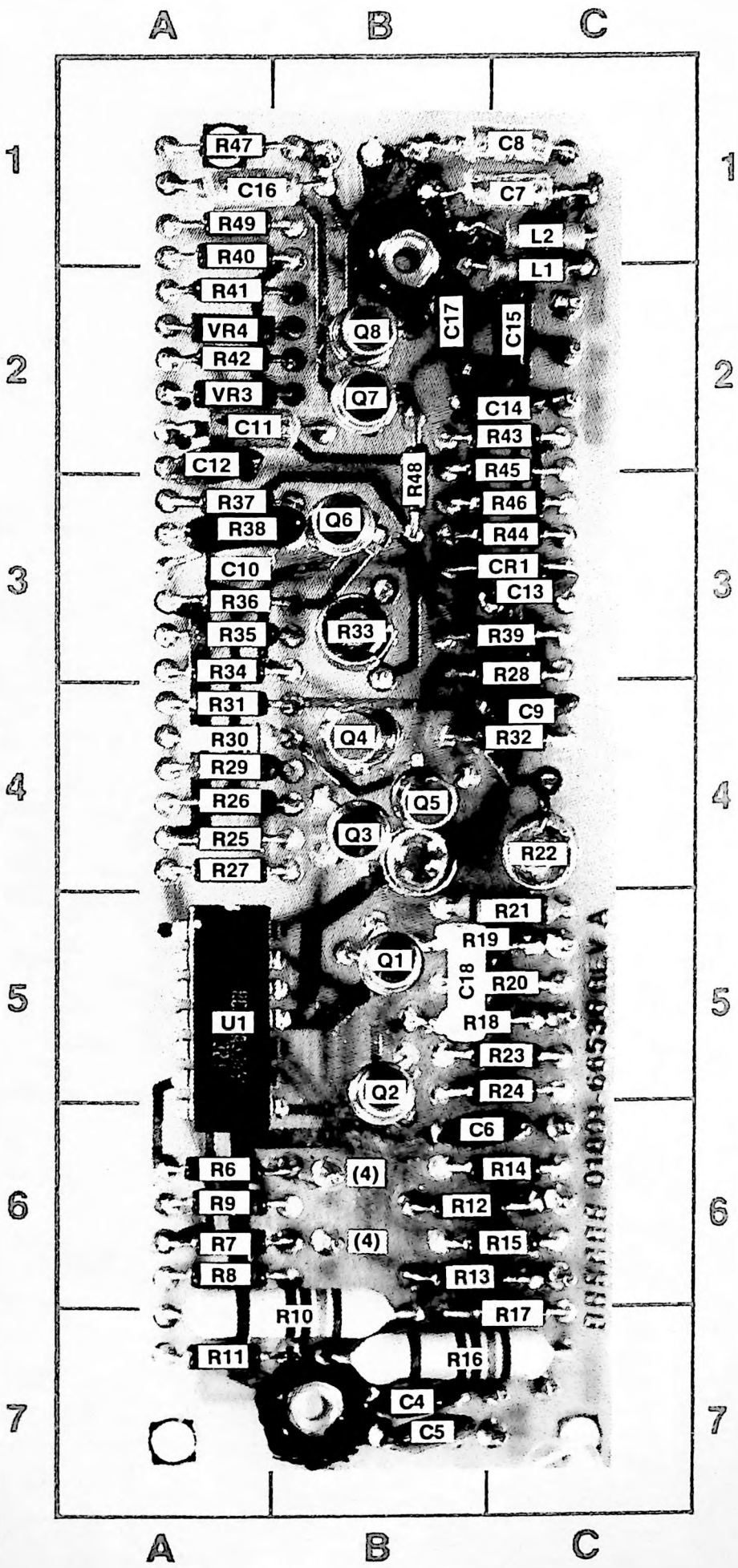


REFERENCE DESIGNATIONS

A4
C1-12 CR1-10 L1-3 Q1-5 R1-23 VR1,2
CHASSIS PARTS
C6,7 J4 P/O S1 P1 W2,3, P/O W4

DELETED:

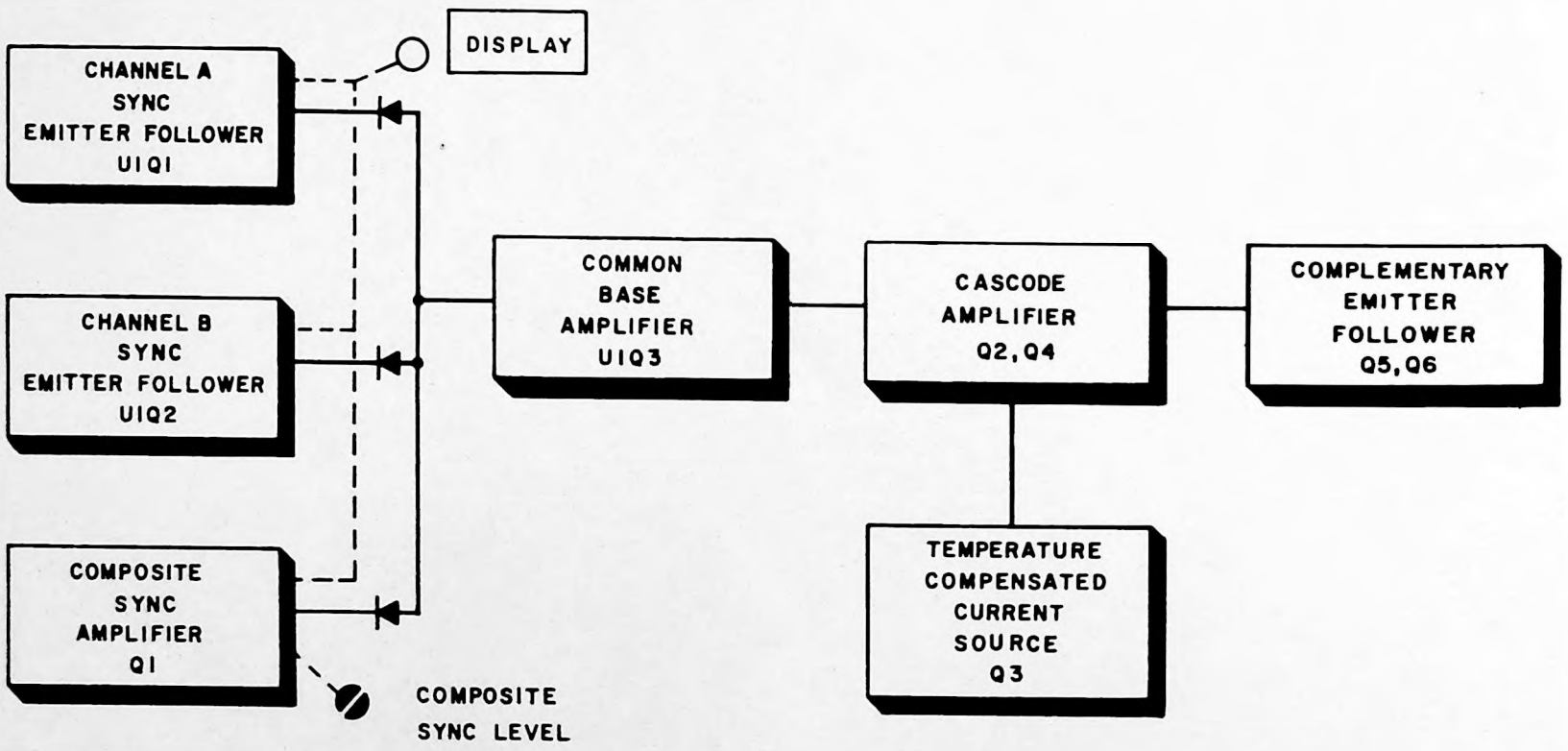
Figure 8-16.
Multivibrator Schematic Diagram
8-11



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C4	B-7	R16	B-7
C5	B-7	R17	C-7
C6	B-6	R18	C-5
C7	C-1	R19	C-5
C8	C-1	R20	C-5
C9	C-4	R21	C-5
C10	A-3	R22	C-4
C11	A-2	R23	C-5
C12	A-2	R24	C-5
C13	C-3	R25	A-4
C14	C-2	R26	A-4
C15	C-2	R27	A-4
C16	A-1	R28	C-3
C17	B-2	R29	A-4
C18	B-5	R30	A-4
CR1	C-3	R31	A-4
L1	C-2	R32	C-4
L2	C-1	R33	B-3
Q1	B-5	R34	A-3
Q2	B-5	R35	A-3
Q3	B-4	R36	A-3
Q4	B-4	R37	A-3
Q5	B-4	R38	A-3
Q6	B-3	R39	C-3
Q7	B-2	R40	A-1
Q8	B-2	R41	A-2
R6	A-6	R42	A-2
R7	A-6	R43	C-2
R8	A-6	R44	C-3
R9	A-6	R45	C-2
R10	B-7	R46	C-3
R11	A-7	R47	A-1
R12	B-6	R48	B-3
R13	B-6	R49	A-1
R14	C-6	U1	A-5
R15	C-6	VR3	A-2
		VR4	A-2

1801A-003

Figure 8-17. Component Identification for A5



1801A-8-12

Figure 8-18. Sync Amplifier Block Diagram

DC VOLTAGE MEASUREMENT CONDITIONS

Control Settings:

Model 180A/AR

MAGNIFIER	X1
DISPLAY	INT

Model 1801A

DISPLAY	A
POLARITY, both channels	+UP
VOLTS/DIV, both channels	1
Vernier, both channels	CAL
Input coupling, both channels	GND
POSITION, A	center trace

*DC voltage measurement taken with DISPLAY switch set to Channel B.

**DC voltage measurement taken with DISPLAY switch set to A+B/COMP.

WAVEFORM MEASUREMENT CONDITIONS

1. Control Settings:

Model 1801A

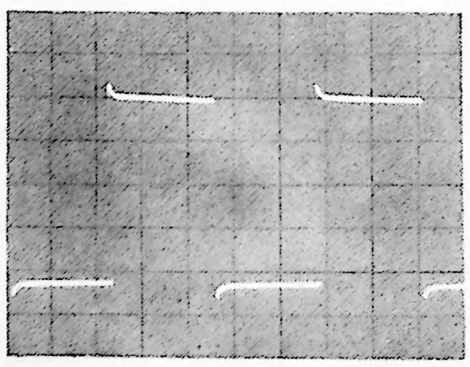
VOLTS/DIV, both channels	1
Vernier, both channels	CAL
POLARITY, both channels	+UP
DISPLAY	A
POSITION, both channels	center trace
Input coupling, both channels	AC

2. Connect Model 180A/AR CALIBRATOR 10V output (pk-pk, 1 kc) to the Model 1801A Channel A INPUT.

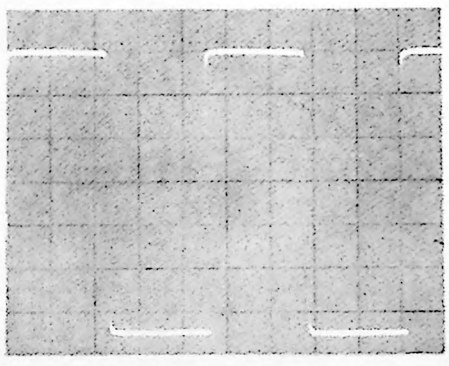
21 1V/DIV
2MS/DIV

22 .1V/DIV
.2MS/DIV

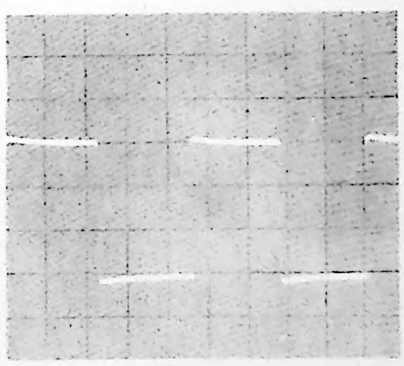
23 .1V/DIV
.2MS/DIV



24 .5V/DIV
.2MS/DIV



25 .5V/DIV
.2MS/DIV



26 1V/DIV
.2MS/DIV

1801A–002

Figure 8-19. Sync Amplifier Measurement Conditions

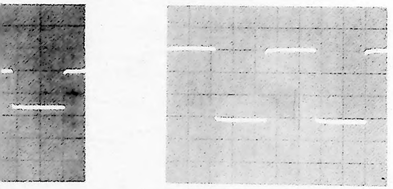
WAVEFORM MEASUREMENT CONDITIONS

. Control Settings:

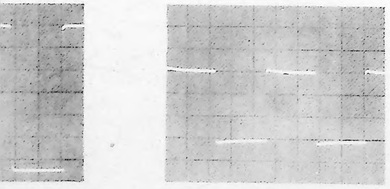
Model 1801A

VOLTS/DIV, both channels	1
Vernier, both channels	CAL
POLARITY, both channels	+UP
DISPLAY	A
POSITION, both channels	center trace
Input coupling, both channels	AC

. Connect Model 180A/AR CALIBRATOR 10V output pk-pk, 1 kc) to the Model 1801A Channel A INPUT.



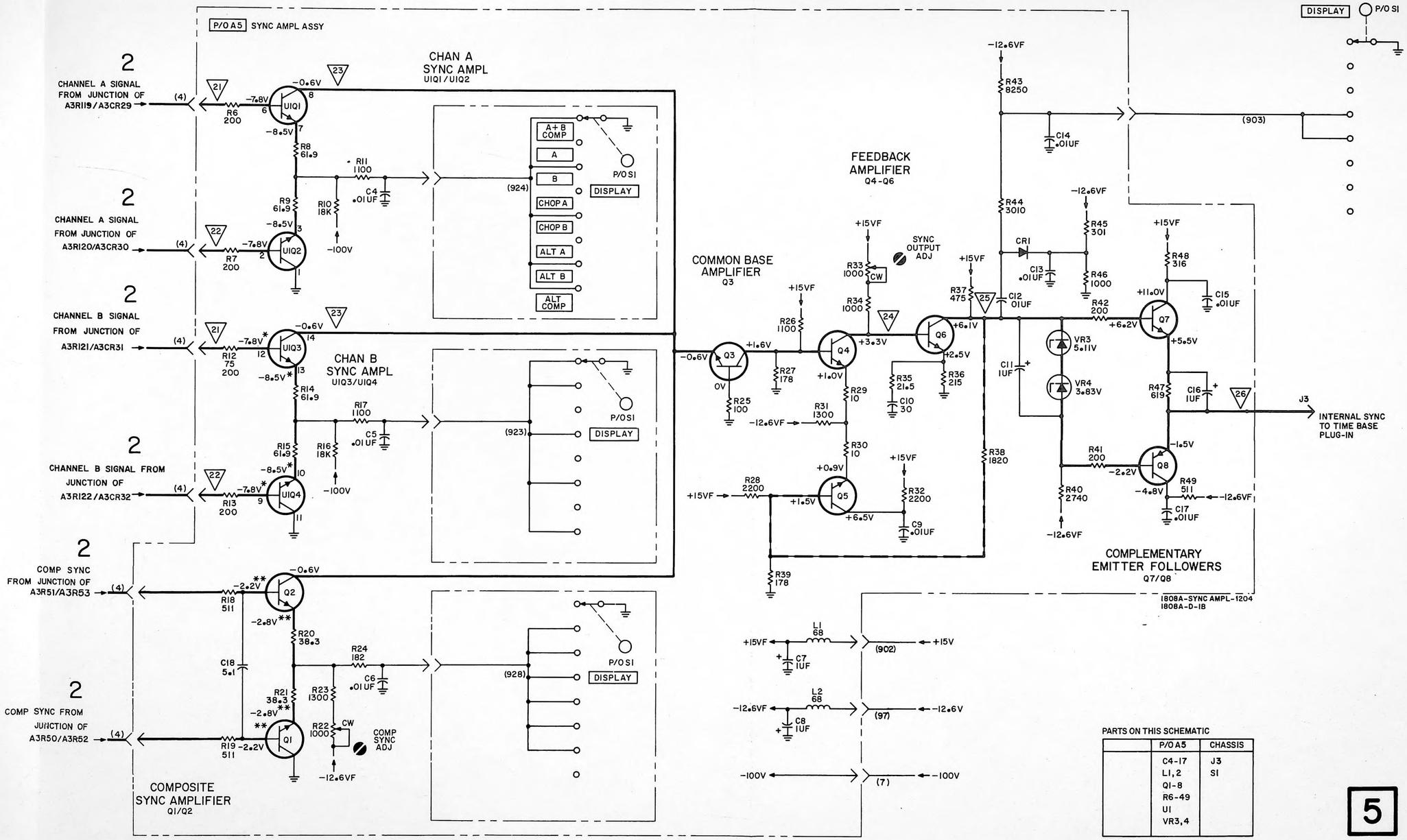
23 .1V/DIV .2MS/DIV



26 1V/DIV .2MS/DIV

1801A–002

Measurement Conditions



PARTS ON THIS SCHEMATIC

	P/O A5	CHASSIS
	C4-17	J3
	L1,2	S1
	Q1-8	
	R6-49	
	U1	
	VR3,4	

DELETED:

5

Figure 8-20.
Sync Amplifier Schematic
8-13

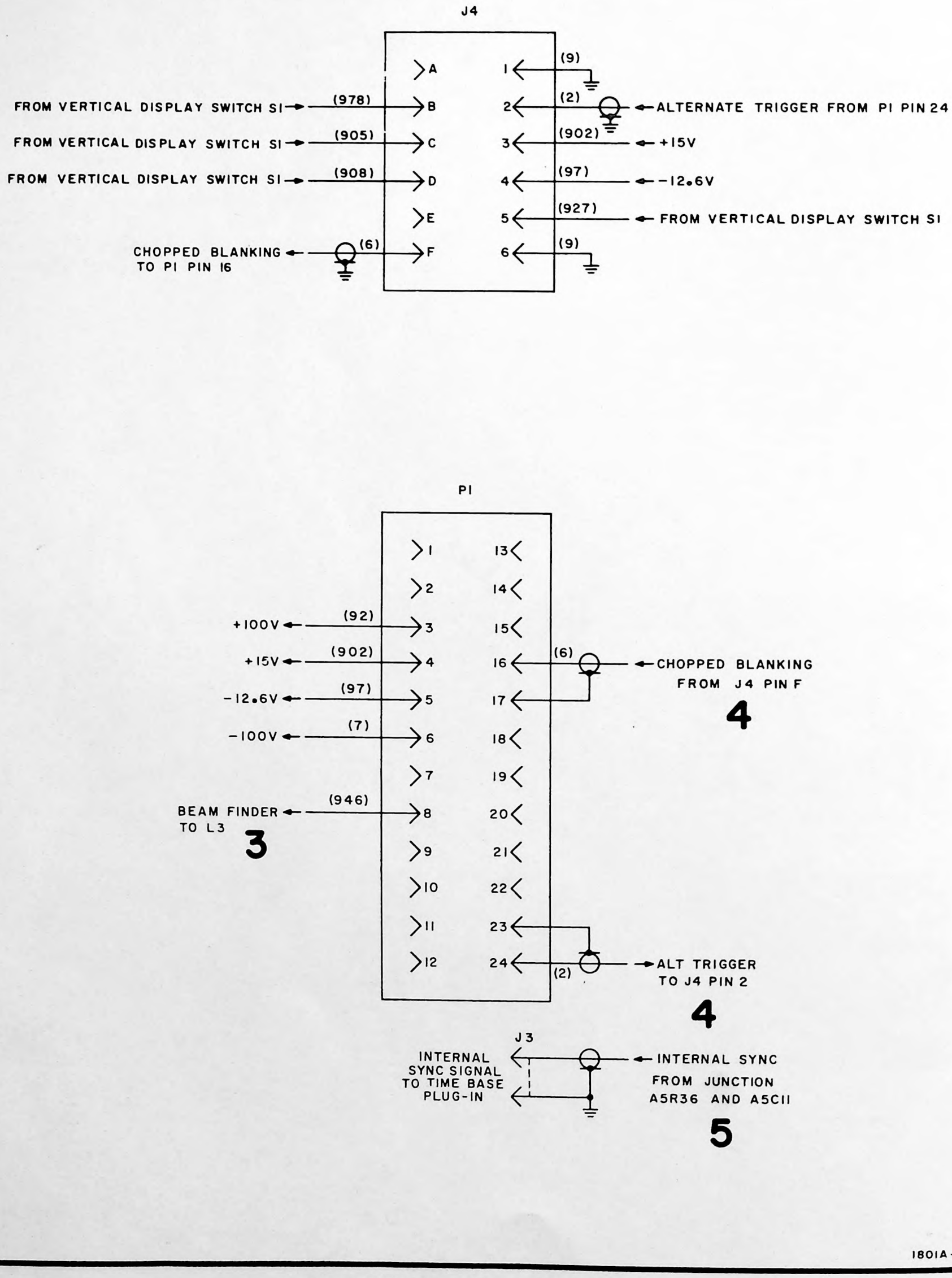


Figure 8-21. Plug and Jack Connections

APPENDIX I

10:1 VOLTAGE DIVIDER PROBE

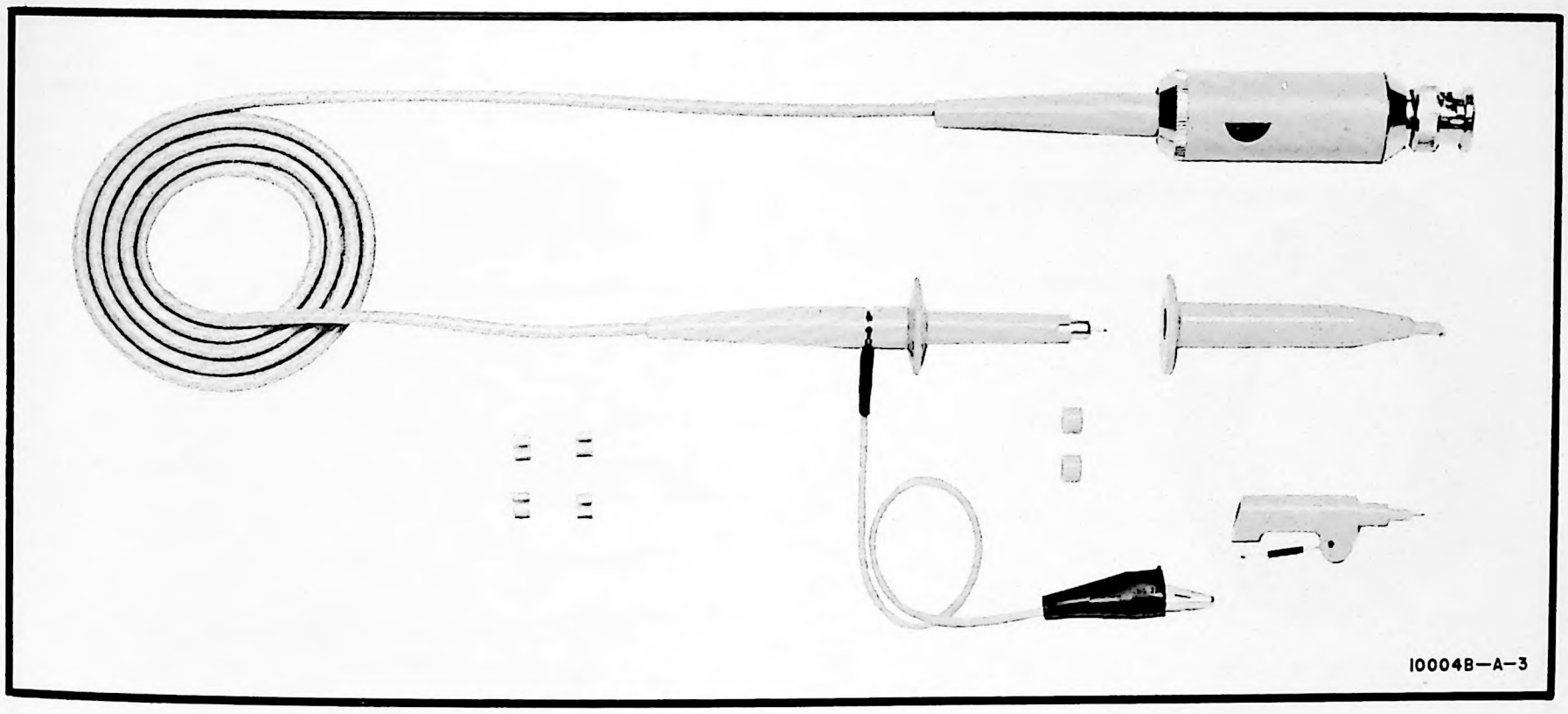


Figure 1. Model 10004B, 10005B, 10006B, 10012B Probes

1. INTRODUCTION.

2. The HP Models 10004B, 10005B, 10006B, and 10012B 10:1 Voltage Divider Probes (Figure 1) provide the low input capacitance and high input resistance required for accurate signal measurements. These probes are designed for use with Oscilloscopes having an input resistance of 1 megohm shunted by a capacitance of 17 to 30 pF (30 to 55 pF for Model 10012B). The improved long-life assembly is easily maintained and provides simple spin-off spin-on cable assembly replacement that requires no additional high frequency compensation procedures after cable replacement. Refer to Table 1 for complete specifications.

3. A number of accessories are supplied with each probe to provide greater usefulness and versatility. The ground lead can be quickly and easily snapped on or off the probe.

Table 1. Specifications

(When compensated to an oscilloscope having an input resistance of one megohm shunted by 17 to 30 pF for Models 10004B, 10005B, 10006B; or 30 to 55 pF for Model 10012B.)

Probe input RC: 10 megohms shunted by approx:

10 pF (Model 10004B)
17 pF (Model 10005B)
14 pF (Model 10006B)
16 pF (Model 10012B)

Division Ratio: 10:1 ±3%.

Risetime and Bandwidth: maintains the specified risetime and bandwidth performance of associated HP equipment.

Voltage Rating: 500 volts peak.

Compensation range: Models 10004B, 10005B, and 10006B will compensate oscilloscope inputs having a capacitance between 17 and 30 pF; Model 10012B between 30 and 55 pF.

Approx. Over-all Length:

3 1/2 ft (Model 10004B)
10 ft (Model 10005B)
6 ft (Model 10006B)
6 ft (Model 10012B)

Output Connector: BNC

Accessories Supplied: A retractable hook tip, an 8 inch ground lead, two insulator caps, and four indicator sleeves. Models 10004B, 10005B, and 10006B also have a press-on spanner tip.

Weight: net, 4 oz.; shipping 1 lb.

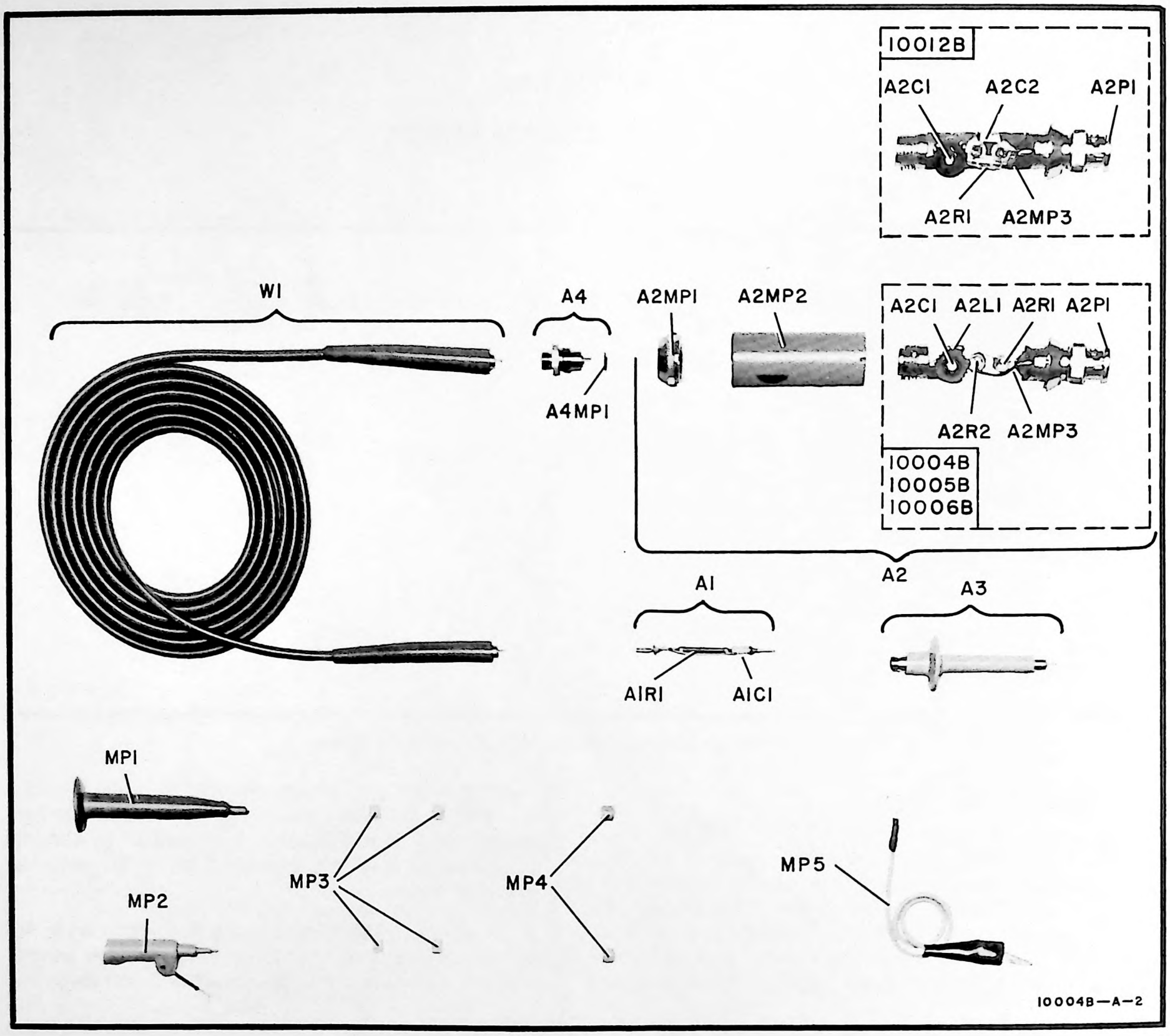


Figure 2. Probe Assembly and Accessories

A press-on retractable hook tip provides a convenient method of connecting to a signal source. Press-on insulator caps insulate the exposed ground near the probe tip. Indicator sleeves are useful for identifying a particular probe. In addition, Models 10004B, 10005B, and 10006B have a press-on spanner tip to aid in signal measurements.

4. OPERATION.

5. Probes must be compensated to obtain accurate waveform measurements. Normally, compensation adjustment will be required only when the probe is first attached to the instrument. If, however, the input capacitance of the instrument varies as ranges are switched, the probe should be recompensated. For probe compensation procedures, refer to paragraph 7.

6. The retractable hook tip and the spanner tip for the probe are attached by slipping them over the probe and pressing them on. Rotate the spanner tip to make certain the lugs of the tip are seated in the probe notches. The hook tip can be rotated on the probe without removal. Indicator sleeves snap onto the probe cable for rapid probe identification. A spring snap-on ground lead fits on the exposed ground connection of the probe barrel. When not in use, the probe tip can be protected from damage by placing the hook tip or spanner tip on the probe.

Table 2. Recommended Test Equipment

Type	Model	Required Characteristics	Ref Para
Oscilloscope (10004B, 5B, 6B)	HP Model 180A/AR w/1801A & 1820A	Input RC: 1 megohm shunted by 17-30 pF, 0.1 V/div, 50 nsec/div.	10, 11
Oscilloscope (10012B)	HP Model 180A/AR w/1806A & 1820A	Input RC: 1 megohm shunted by 30-55 pF, 0.1 V/Div, 50 nsec/div.	10
Pulse Generator	HP Model 8004A	Risetime: < 1.5 nsec, 100 kHz.	11-a
Probe-tip to BNC adapter	HP Model 10011A		11-c
50-ohm Feed-through Termination	HP Model 10100A	±1 ohm	11-c

7. ADJUSTMENT.

8. Table 2 lists test equipment recommended to perform the adjustments. See Figure 2 for adjustment locations and Figures 3 and 4 for the probe schematics.

NOTE

When adjusting the Model 10012B, replace the Model 1801A plug-in with the Model 1806A.

9. LOW FREQUENCY COMPENSATION.

10. Connect the probe BNC to the Vertical plug-in input.

a. Set:

Magnifier X1
Time/div ..... 0.5 msec/div
Volts/div 0.2

b. Connect the probe tip to the 10V, 1 kHz square-wave output signal from the calibrator.

c. Obtain a stable display.

d. Adjust A2C1 (thumbwheel adjustment) for a flat-topped waveform.

11. HIGH FREQUENCY COMPENSATION. (Models 10004B, 10005B, and 10006B only).

NOTE

When cable assembly W1 is replaced, do not perform the following procedures.

a. Connect the probe through the probe-tip to BNC adapter and the 50-ohm feed-through termination to the Pulse Generator output. Unscrew knurled ring A2MP1 and remove chassis tube A2MP2 for access to the following adjustments.

b. Set:

Magnifier X1
Time/div ..... 0.05 usec/div
Volts/div 0.1

c. Set the Pulse Generator for a repetition rate of 100 kHz and set the amplitude to give a minimum vertical deflection of 5 divisions.

d. Set A2R2 fully cw.

e. Adjust A2R1 for best flat-top response without overshoot and with minimum leading edge rounding.

f. Adjust A2R2 to obtain a sharp corner with little or no leading edge spike.

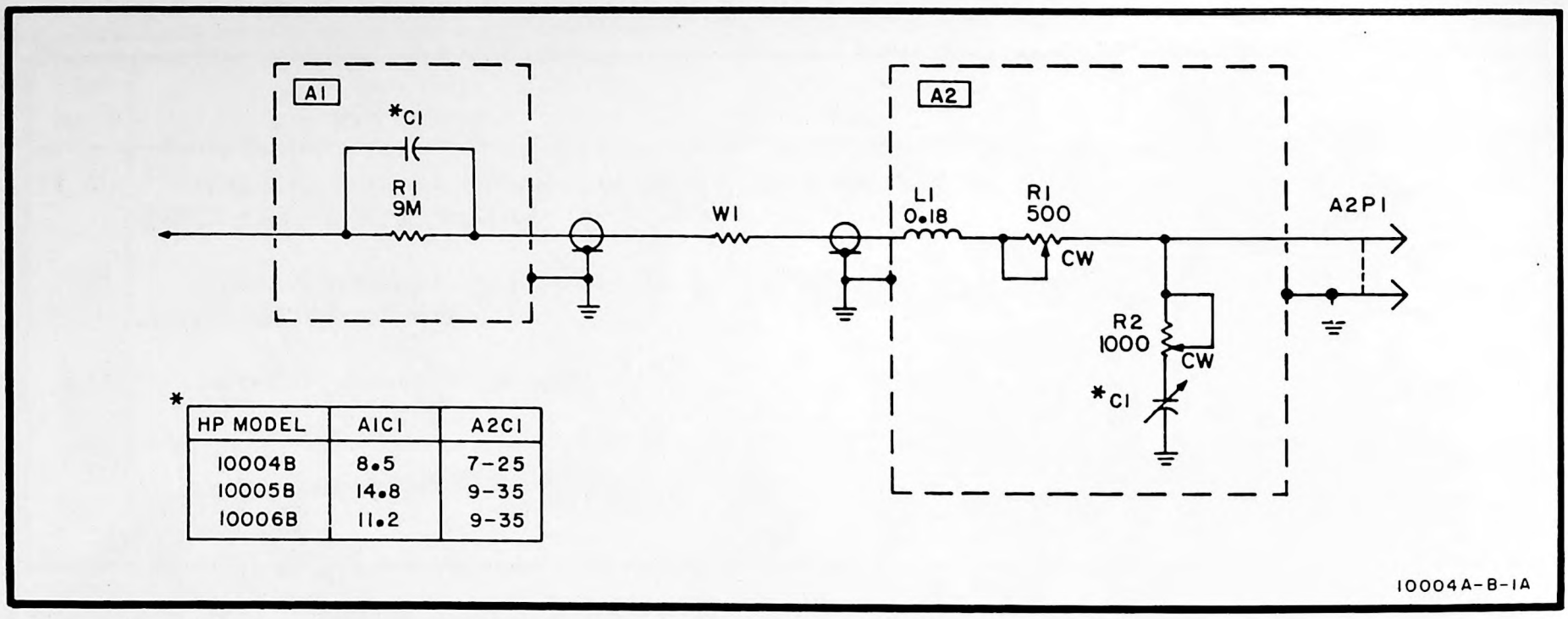
g. Adjust A2R1 to obtain a leading edge amplitude equal to remainder of flat-top pulse.

12. MAINTENANCE.

13. Figure 2 shows an exploded view of the probe with its accessories. Do not disassemble the probe any further than shown. If a faulty part is located in a part of the probe that cannot be disassembled, it should be returned to the nearest Hewlett-Packard Sales/Service Office for repair or replacement.

14. REPLACEABLE PARTS.

15. Replaceable parts for the probes are illustrated in Figure 2 and listed in Table 3. When ordering a part, address the order to your nearest Hewlett-Packard Sales/Service Office. Provide the model number of the probe and a complete description (including the HP Part No.) of the required components.



*

HP MODEL	A1C1	A2C1
10004B	8.5	7-25
10005B	14.8	9-35
10006B	11.2	9-35

Figure 3. Models 10004B, 10005B, 10006B Schematic

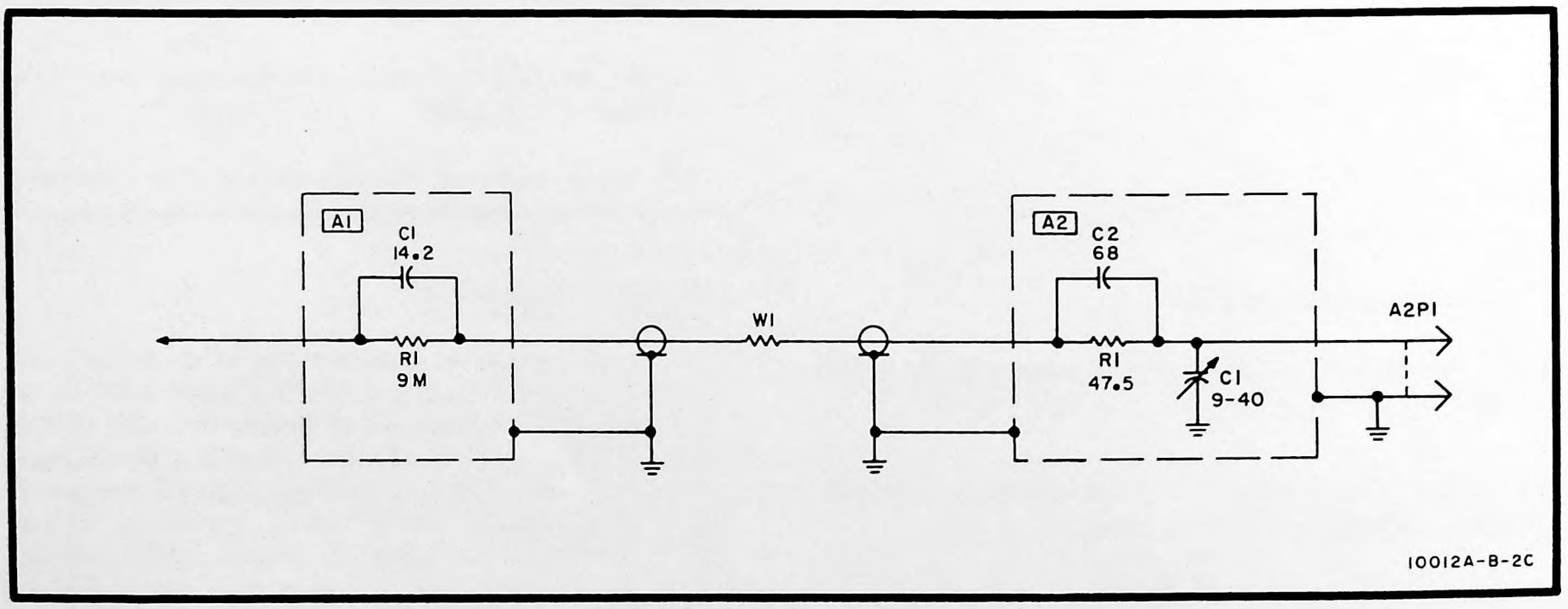


Figure 4. Model 10012B Schematic

Table 3. Replaceable Parts

Ref Desig	HP Part No.	TQ	Description
A1	10004-69503	1	Assy: attenuator, includes C1 and R1 (Model 10004B)
	10005-69502	1	Assy: attenuator, includes C1 and R1 (Model 10005B)
	10006-69502	1	Assy: attenuator, includes C1 and R1 (Model 10006B)
	10012-69502	1	Assy: attenuator, includes C1 and R1 (Model 10012B)
A2	10004-62102	1	Assy: compensation (Model 10004B)
	10005-62101	1	Assy: compensation (Model 10005B)
	10006-62101	1	Assy: compensation (Model 10006B)
	10012-62102	1	Assy: compensation (Model 10012B)
A2C1	0121-0408	1	C: var cer 7-25 pF (Model 10004B)
	0121-0409	1	C: var cer 9-35 pF (Models 10005B, 10006B)
	5080-0447	1	C: var cer 9-40 pF (Model 10012B)
A2C2	0160-3328	1	C: fxd cer 68 pF 10% 200 wVdc (Model 10012B)
A2L1	9100-2250	1	L: inductor (Models 10004B, 10005B, 10006B)
A2MP1	10004-22501	1	Ring: knurled
A2MP2	10004-69510	1	Tube: chassis
	10005-69506	1	Tube: chassis
	10006-69506	1	Tube: chassis
	10012-69505	1	Tube: chassis
A2MP3	10004-20101	1	Assy: chassis
A2P1	1250-0045	1	P: BNC
A2R1	2100-2803	1	R: var 500 ohms 30% 1/2W (Models 10004B, 10005B, 10006B)
	0757-0393	1	R: fxd metflm 47.5 ohms 1% 1/8W (Model 10012B)
A2R2	2100-2804	1	R: var 1000 ohms 30% 1/2W (Models 10004B, 10005B, 10006B)
A3	10004-67701	1	Assy: probe
A4	10004-69511	1	Assy: spin off adapter
A4MP1	2190-0469	1	Washer: int lock, I.D. 0.116 in., O.D. 0.265 in.
W1	10004-61604	1	Assy: cable, 3'6" (Model 10004B)
	10005-61601	1	Assy: cable, 10' (Model 10005B)
	10006-61601	1	Assy: cable, 6' (Models 10006B, 10012B)
			Accessories
MP1	10004-67604	1	Assy: hook tip
MP2	10004-67601	1	Assy: spanner tip
MP3	7124-2020	1	Sleeve: indicator, A
	7124-2021	1	Sleeve: indicator, B
	7124-2022	1	Sleeve: indicator, C
	7124-2023	1	Sleeve: indicator, D
MP4	10004-45401	2	Cap: insulator
MP5	10004-61301	1	Assy: ground lead

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